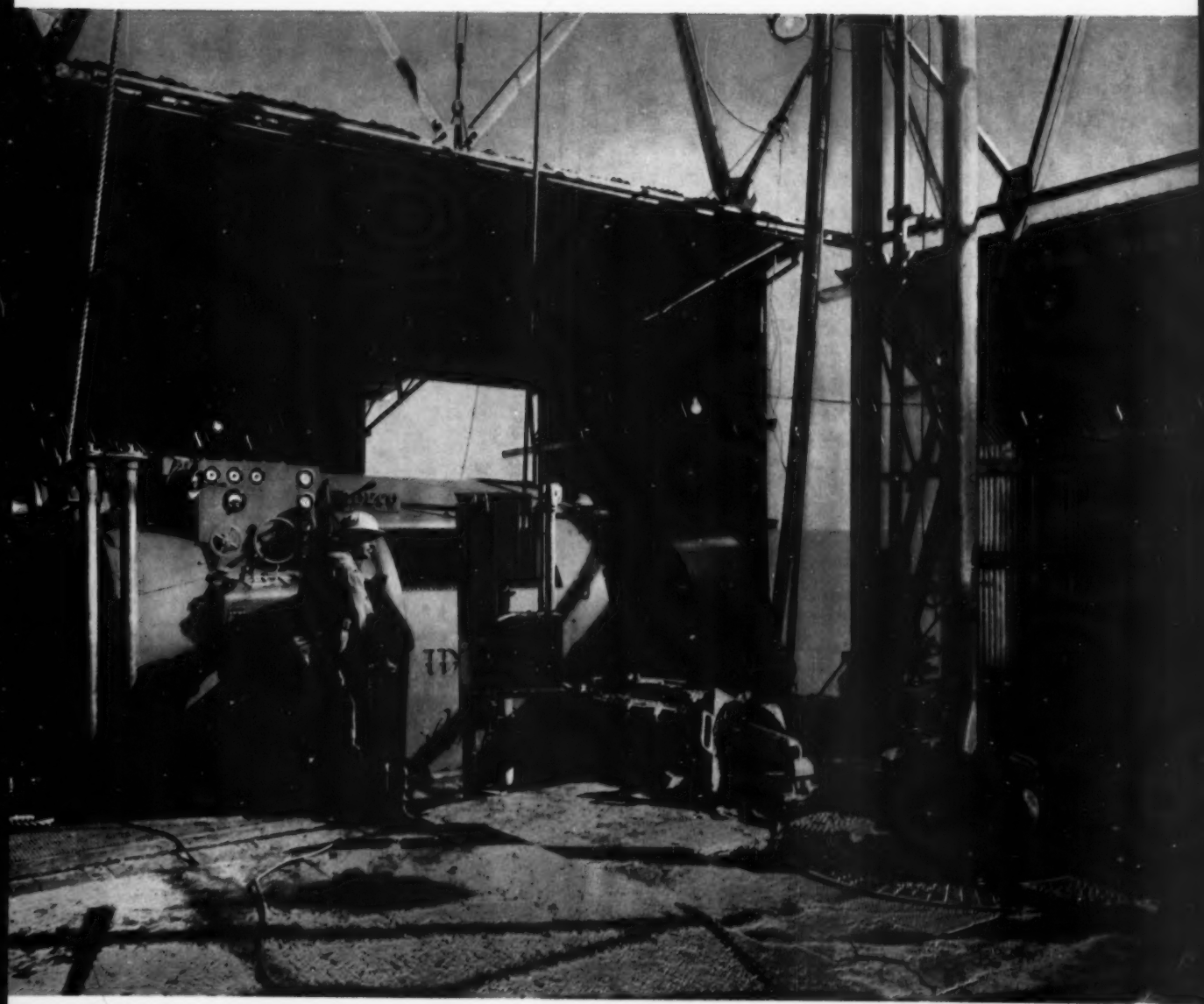
World Petroleum

march, 1951



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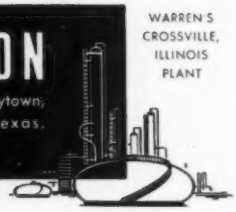

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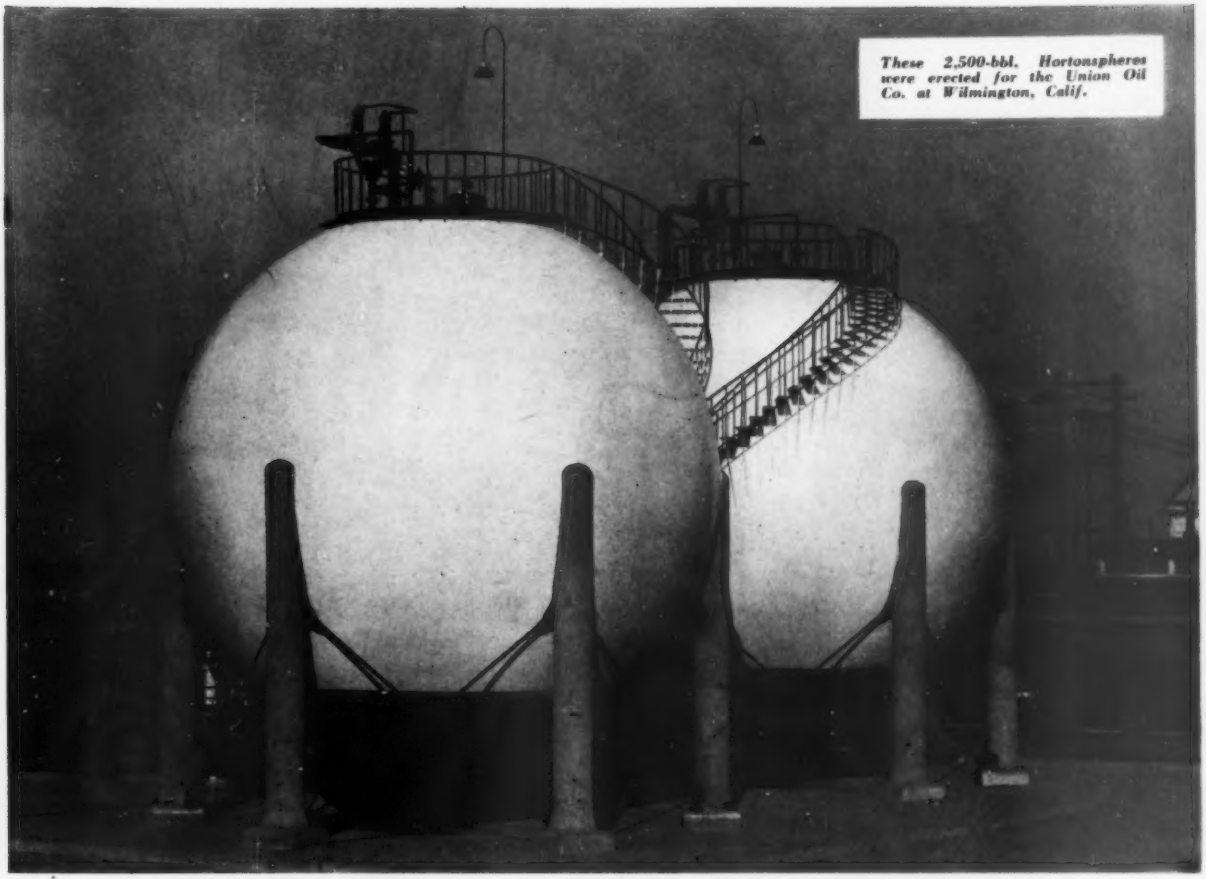
Crude Oil, Natural Gasoline and Liquefied Petroleum Products



These 2,500-bbl. Hortonspheres were erected for the Union Oil Co. at Wilmington, Calif.

POSITIVE PROTECTION in *Economical* form

Hortonspheres

These high pressure tanks provide every essential protection you need when storing light hydrocarbons . . . and do it more economically than any other container for this service.

First of all, there is protection from volumetric losses of the hydrocarbon during storage. Hortonspheres are designed to withstand the internal pressure resulting from high volatility and pressure variations caused by daily temperature change. None of the contents will be lost in the form of vapor as long as the internal pressure does not exceed the setting of the relief valve.

Then there's protection against the danger of fire. The vapors inside Hortonspheres do not contain enough oxygen to propagate a flame. Furthermore, by preventing volumetric losses, Hortonspheres also prevent the accumulation of explosive or toxic vapors in the storage area.

You are also protected against interior corrosion. Hortonspheres do *not* draw in oxygen or water vapor through the vents during normal operation. There's little, if any, corrosion on the inside of the shell.

Economy-wise, Hortonspheres offer several outstanding advantages. They save *material* as the spherical form utilizes steel more efficiently than any other container in resisting internal pressures.

They're easier to *maintain* as the entire structure is supported above ground, readily accessible for inspection. They save on space too—the equivalent volume in horizontal cylindrical tanks would require far more ground area.

These are a few reasons why Hortonspheres offer unmatched *efficiency* and *economy* in storing light hydrocarbons like butane and natural gasoline. For details on standard sizes and pressures available, write our nearest office for Bulletin F.

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THAT *Counts* IN EXPLORATION

Modern science and inventive genius are reflected in today's precision equipment and advanced methods designed to determine geophysical data for oil exploration. But these methods and equipment are not enough. The producer of oil wants the most accurate and scientific analysis possible.

That's where INTERPRETATION comes in. Republic is ever seeking new instruments, new methods, new ways and means of giving the producer greater geophysical accuracy. Already their pioneering work and six crew years of experience in surface shooting have uncovered large areas that before were thought unworkable. Thus, by linking better equipment . . . new methods . . . skillful interpretation and experience, Republic is constantly reaching beyond the normal limits of interpretive analysis.

Rx

REPUBLIC EXPLORATION COMPANY

TULSA, OKLAHOMA MIDLAND, TEXAS

In your "winter specs" for spring construction

It will pay you to consider these four advantages of a Fluor Pulsation Dampening Piping System . . .

1 **Pressure drop calculation based on smoother flow**

2 **Improved gas metering accuracy**

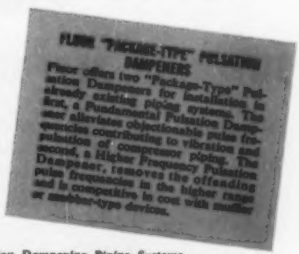
3 **Virtual elimination of piping maintenance**

4 **Consideration of safety records**

The Fluor Pulsation Dampening Piping System is the newest and most practical approach to "pulse-free" piping yet developed. Designed primarily for installation in new construction utilizing piping to handle air, steam, or hydrocarbons at operating pressures ranging from a vacuum to 5,000 psi at any temperature, this Fluor-designed piping system removes objectionable pulse peak pressures caused by the reciprocating action of compressors.

Fluor Pulsation Dampening Piping Systems are *guaranteed* to provide a virtually smooth gas flow with minimum pressure drop. Safety is increased by eliminating vibrational stress on piping, heat exchangers and vessels. Compressor operating efficiency is increased, metering inaccuracies caused by pulsative flow are reduced, and maintenance problems common to conventional piping systems are cut to a minimum.

If you are in the process of drawing up specifications for current or contemplated construction involving compressor piping, it will pay you to write for Fluor Bulletin No. PDS-8501. Or, contact your nearest Fluor Representative for attention to your particular problem.



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Fluor Pulsation Dampeners and Pulsation Dampening Piping Systems are protected by U. S. and foreign patents issued and pending.

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Get the help of the recognized authorities—the Timken Company metallurgists. Through 20 years of development and testing of 23 different analyses to solve specific problems of heat, pressure, corrosion and oxidation, they've gained the experience needed to choose the best steel for *your* job. And you're assured uniform, high quality steel in every tube because of complete, rigid controls—from melting to final tube inspection—practiced in our mills.

Let our "RSQ"—Research, Supply, Quality—solve your tube problems. Ask the experts! The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, O. Cable address: "TIMROSCO".

20 years of extensive testing and research have made the Timken Company the leading authority on high temperature tubing. Photo shows Charpy impact tests.

This month we report on:

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Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200°F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return bend forgings for oil heaters.

23 TIMKEN STEELS FOR HIGH TEMPERATURE SERVICE

Carbon	Sicromo 2	Sicromo 5S	16-13-3*
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	25-20*
DM-2	2¼% Cr.-1% Mo.	Sicromo 7	25-12*
Silmo	Sicromo 3	Sicromo 9M	35-15*
DM	4-6% Cr.-Mo.	18-8 Stainless	16-25-6*
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	

**Available as seamless tubing on an experimental basis only.*

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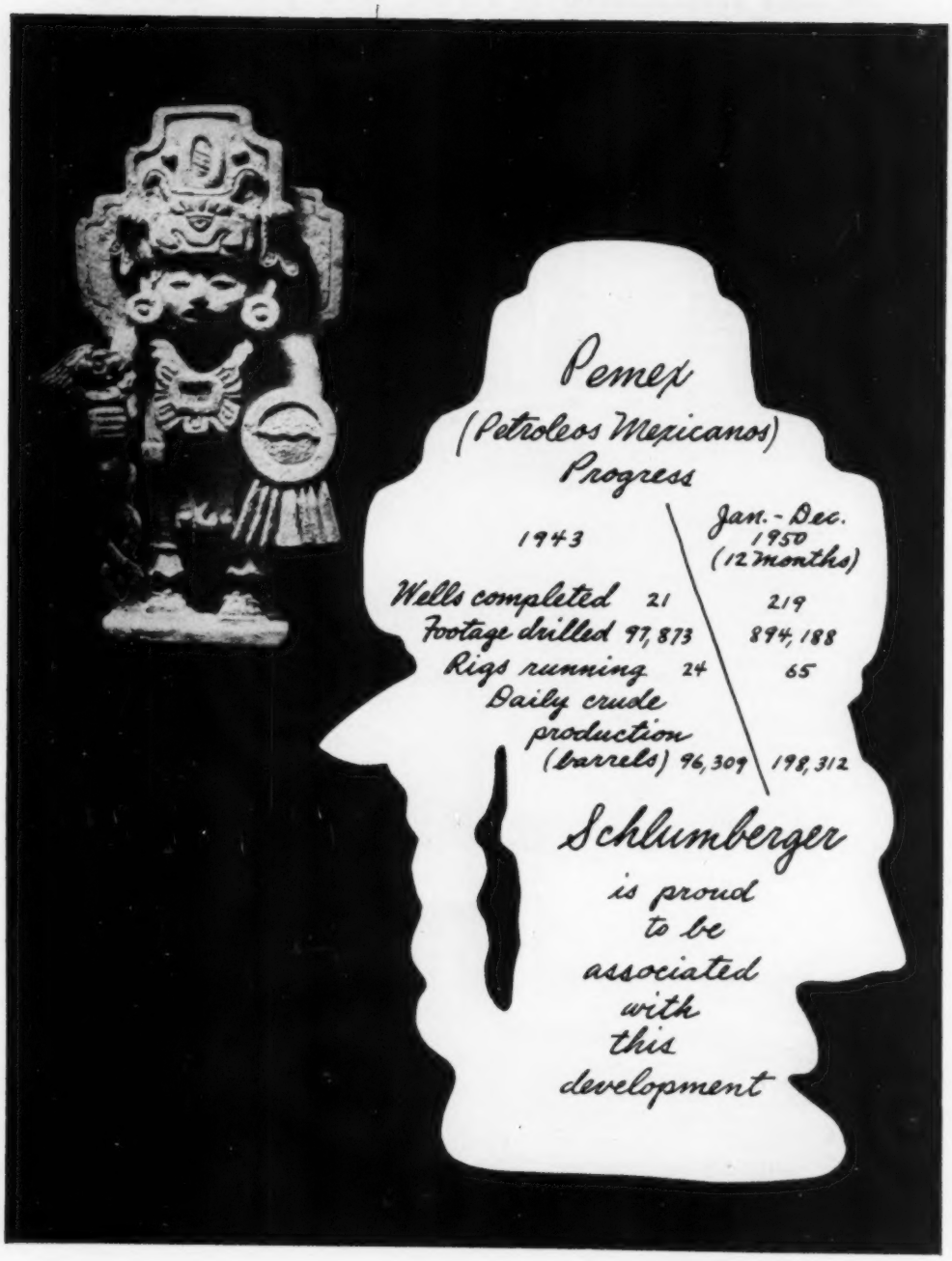
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Progress
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Jan.-Dec. 1950 (12 months)
Wells completed 21 219
Footage drilled 97,873 894,188
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Daily crude production (barrels) 96,309 198,312
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Several times during the drilling of every well cement contamination of mud becomes a problem. These Magcobar Products have been proved effective for pre-treating the mud prior to drilling the cement and restoring the desirable drilling qualities to cement-cut mud. When you encounter cement contamination, use these Magcobar materials . . . separately or in combinations . . . to save rig time and money and eliminate the costly practice of discarding cement-cut mud. Your Magcobar field engineer will gladly give assistance at the rig and there are nearly 300 strategically located Magcobar dealers with stocks of these products, ready to serve you day and night.

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NUMBER SIX

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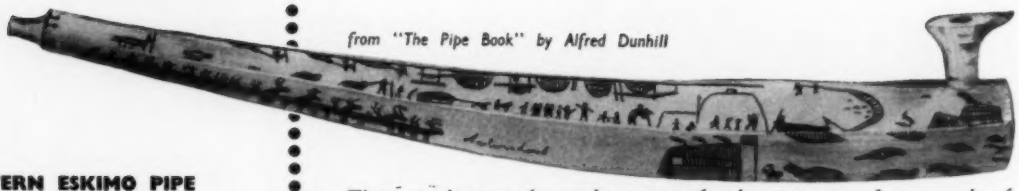

from "The Pipe Book" by Alfred Dunhill

WESTERN ESKIMO PIPE

This reproduction of a smoking pipe of walrus ivory is a fine example of Eskimo art. The scratched drawings are beautifully executed and show a house with chimney, a flag-staff, a herd of tame reindeer, and a large fishing net in use behind the igloo. The boring of the stem has been effected by cutting out a series of oblong panels, subsequently fitted back into place; the pipe can be cleaned by removal of a panel.

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The industrial pipe must be efficiently insulated.

KENYON are prepared to undertake all heat insulation of piping, vessels, plant or equipment, from start to finish. Projects carried out in every part of the world.

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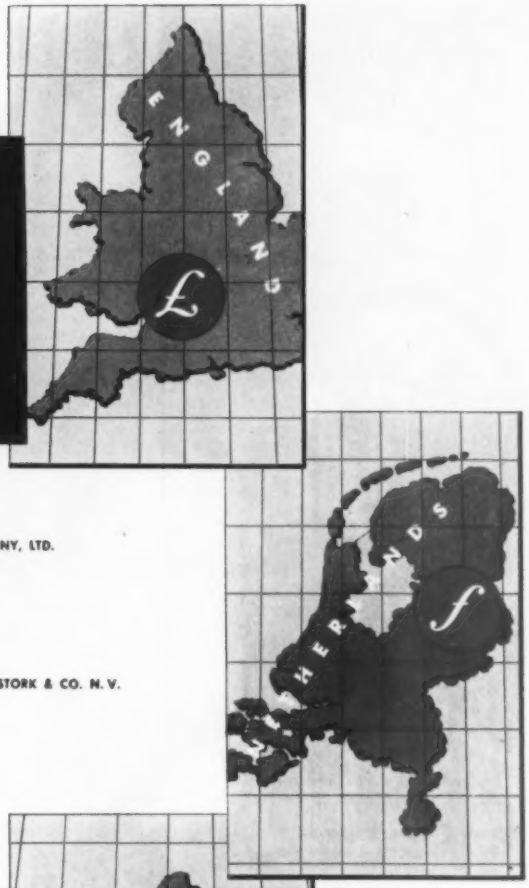

£ *Sterling Area*

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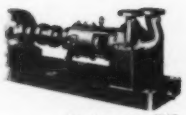
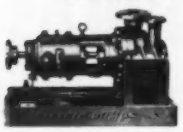
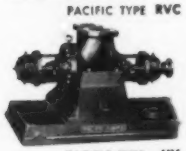

PACIFIC TYPE SVC


PACIFIC TYPE RVC


PACIFIC TYPE HV

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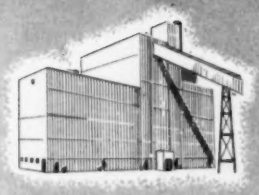
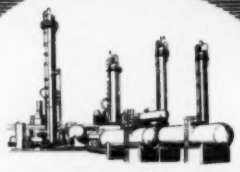
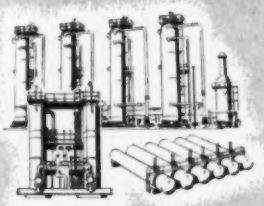


POWER DIVISION

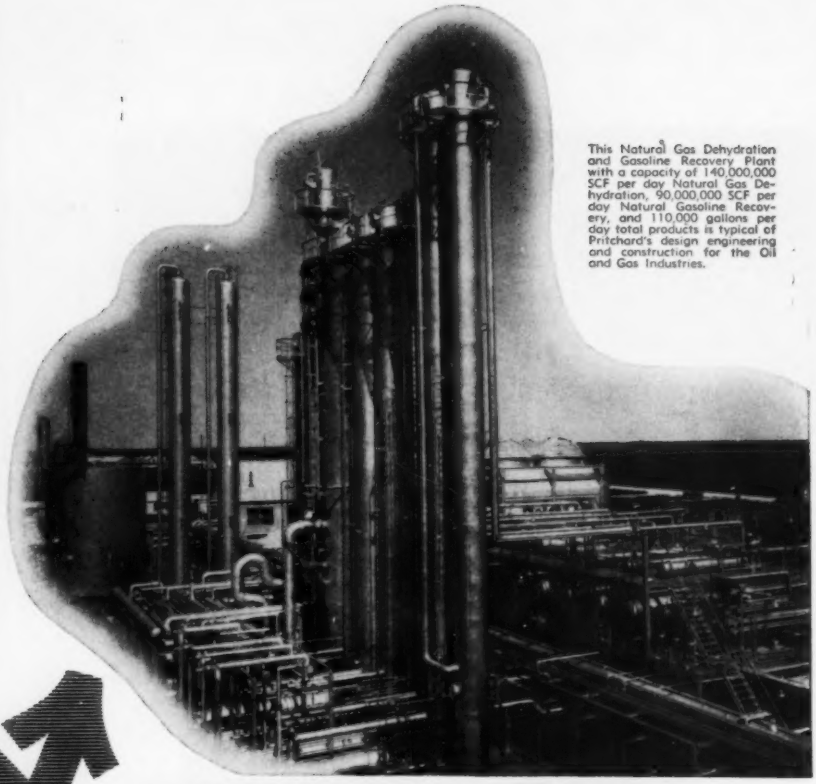
CHEMICAL DIVISION



PETROLEUM DIVISION



NATURAL GAS DIVISION



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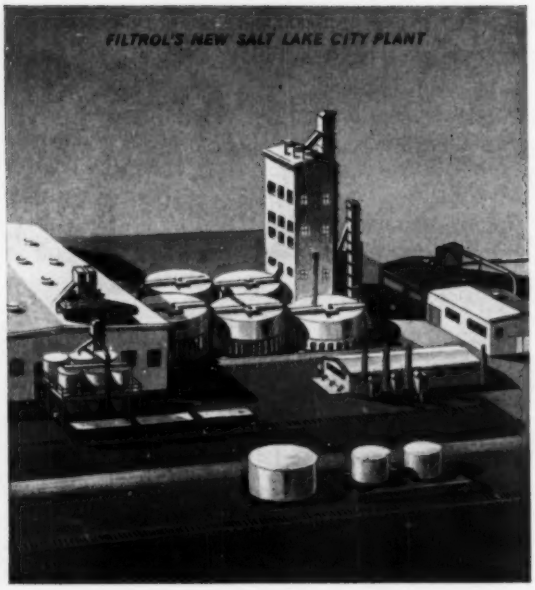

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THESE NEW PRODUCTION FACILITIES SUPPLEMENT FILTROL'S OTHER PLANTS AND GREATLY INCREASE THE AVAILABILITY OF EFFICIENT, LOW COST CATALYSTS FOR REFINERS EVERYWHERE.

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Filtrol

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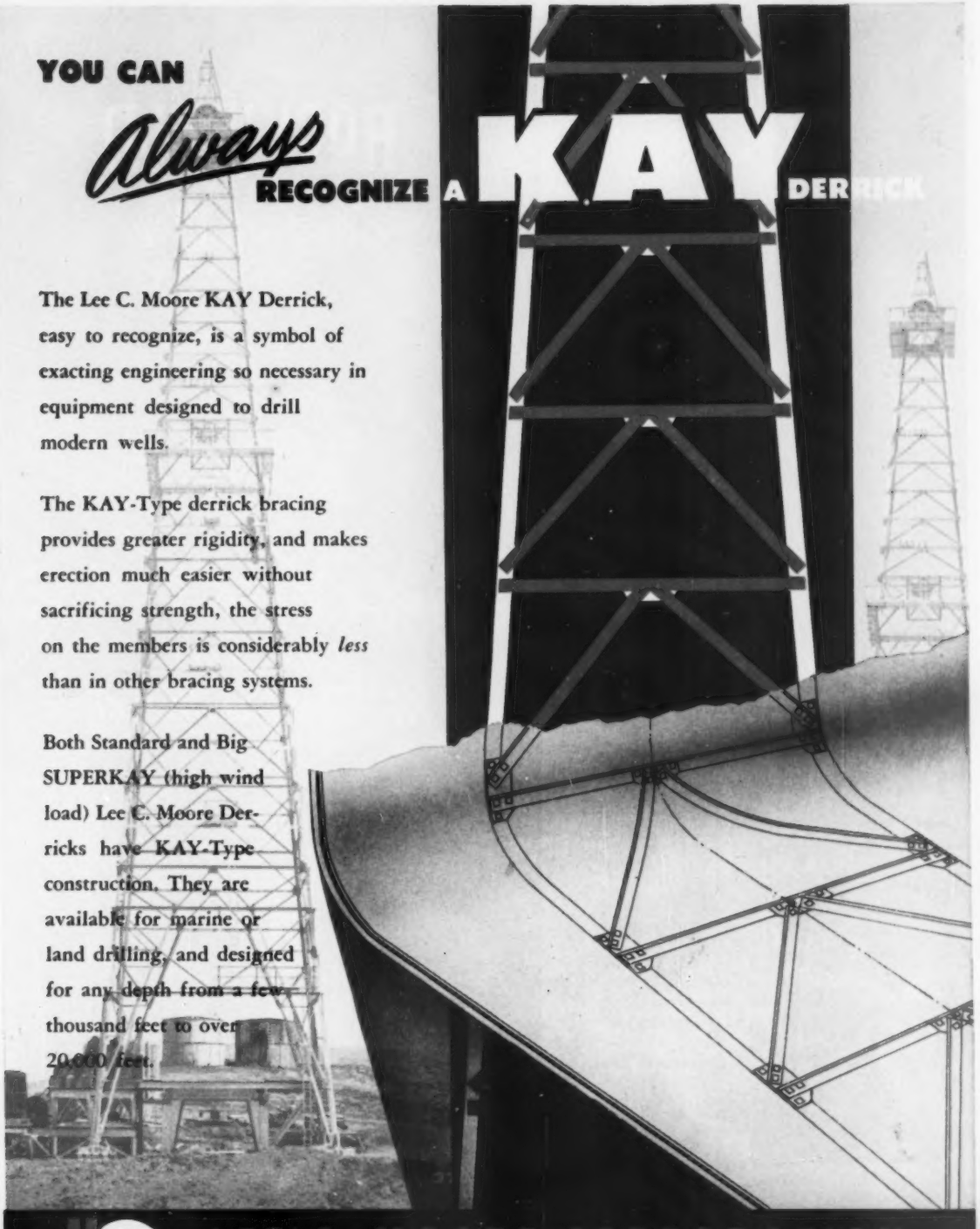

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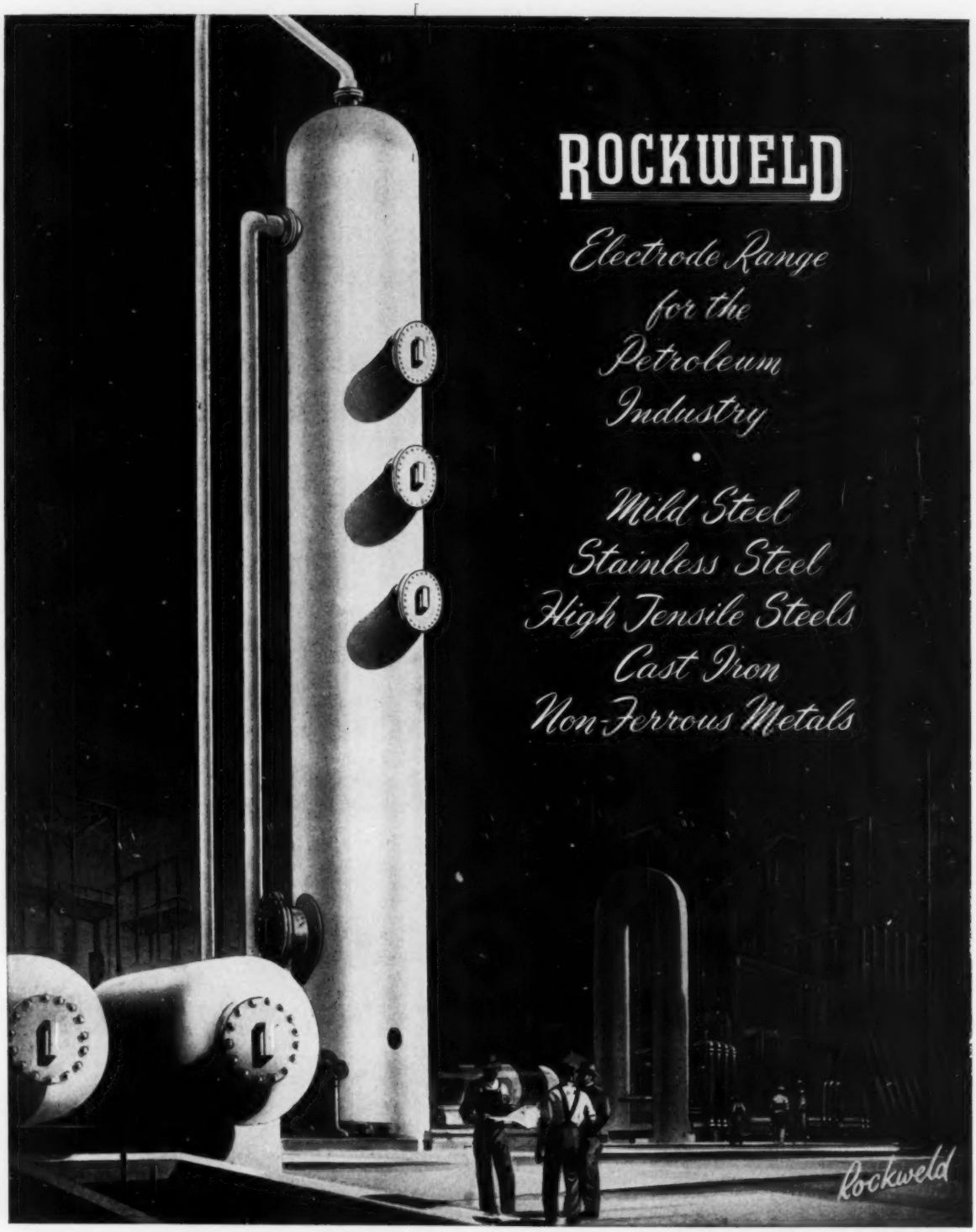

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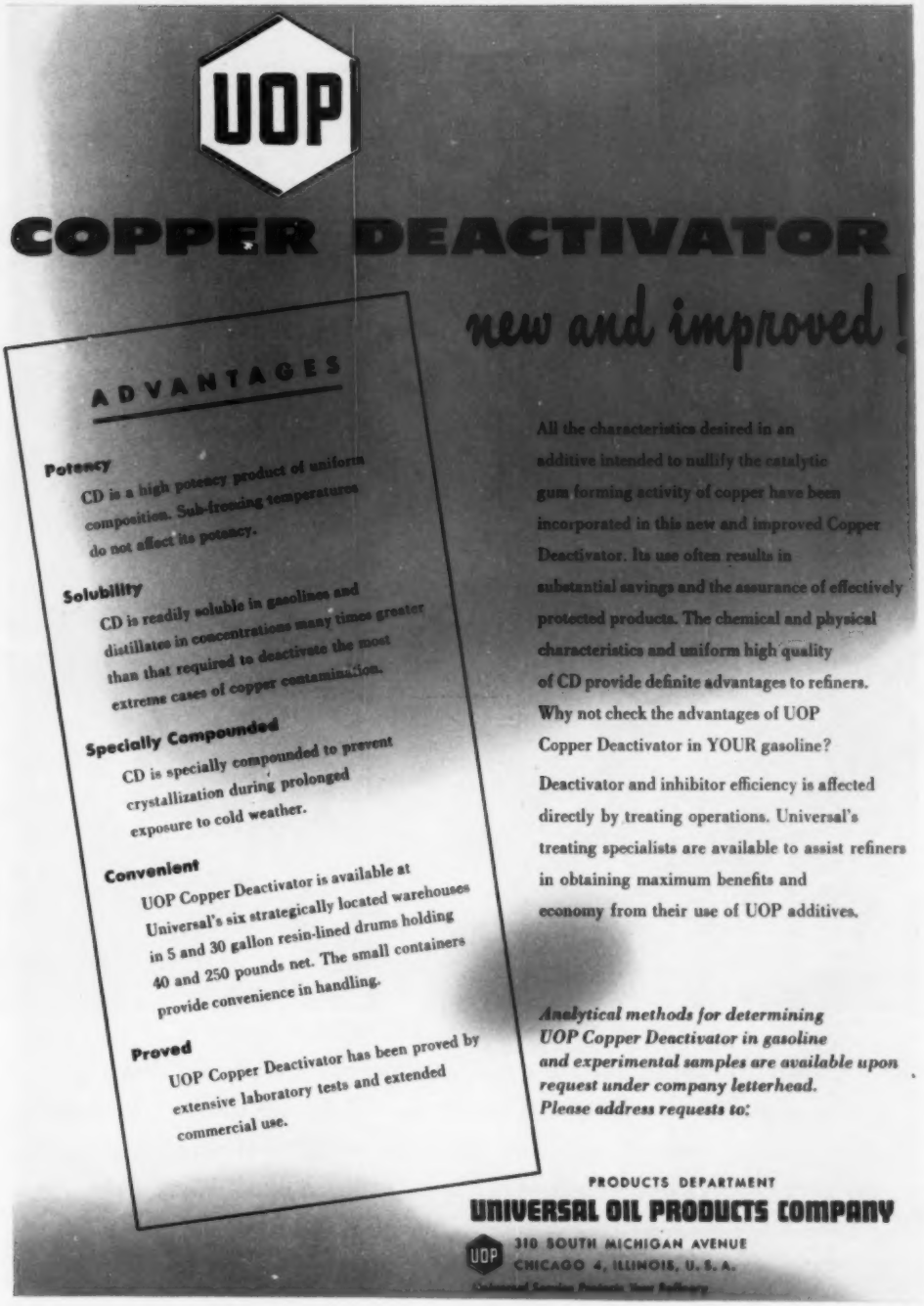
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UNIVERSAL OIL PRODUCTS COMPANY
UOP
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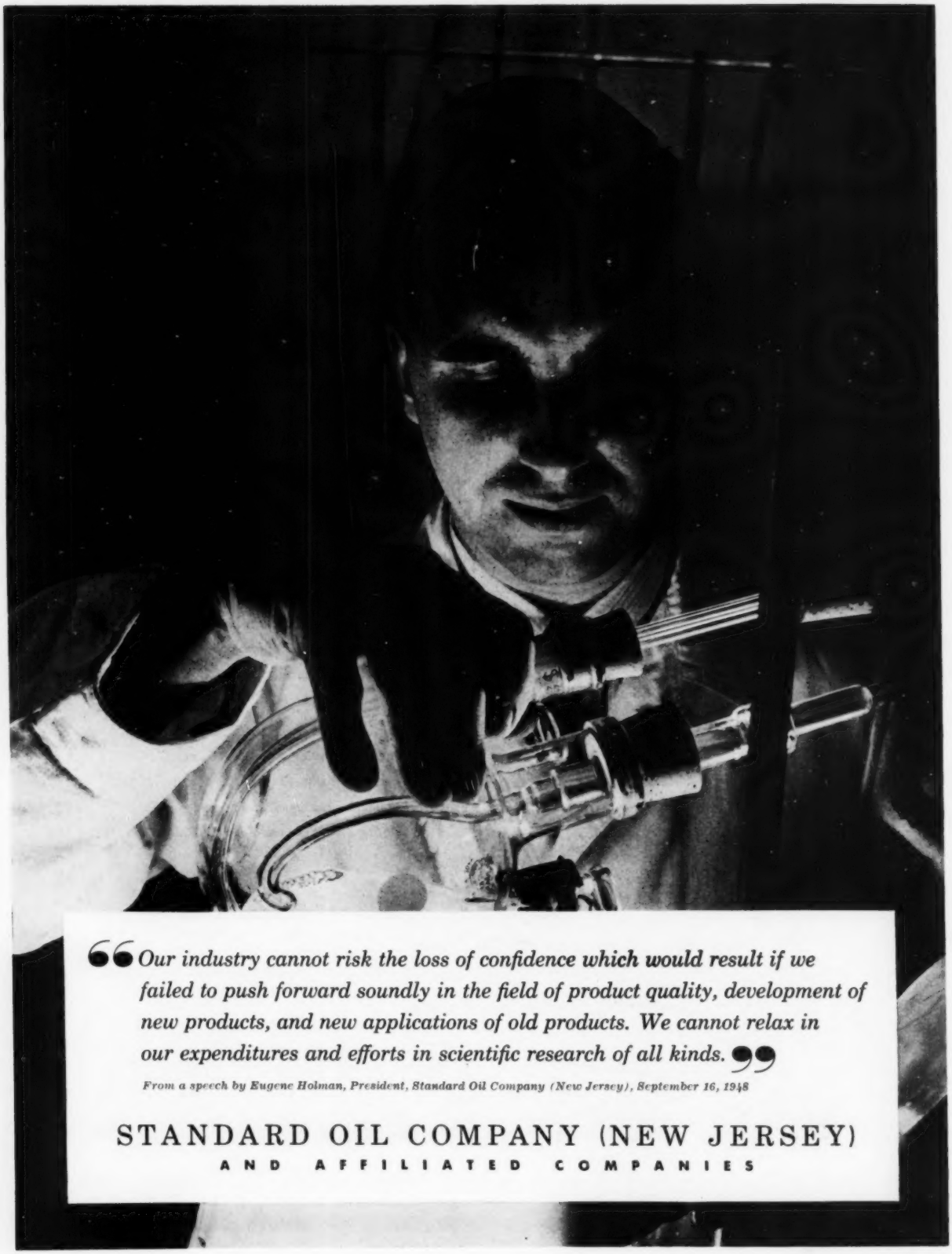
CHICAGO 4, ILLINOIS, U. S. A.



"Our industry cannot risk the loss of confidence which would result if we failed to push forward soundly in the field of product quality, development of new products, and new applications of old products. We cannot relax in our expenditures and efforts in scientific research of all kinds."

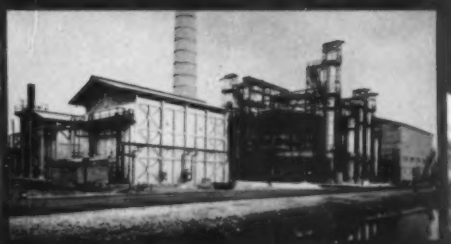
From a speech by Eugene Holman, President, Standard Oil Company (New Jersey), September 16, 1948

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

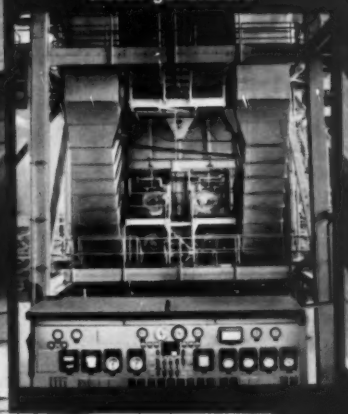
the *complete* engineering service

complete lube oil processing plants



complete chemical plants

dual-circulation
steam generators



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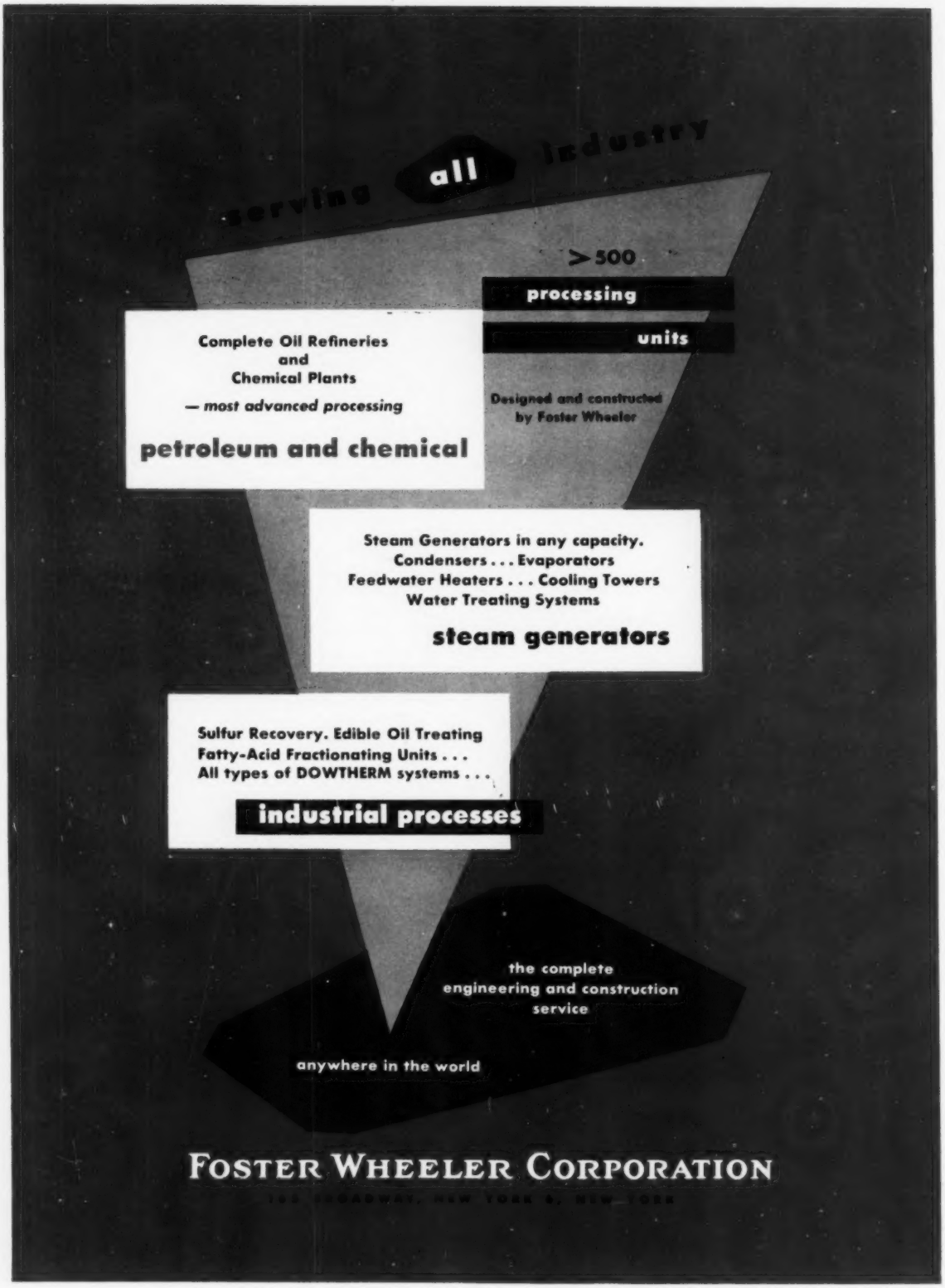
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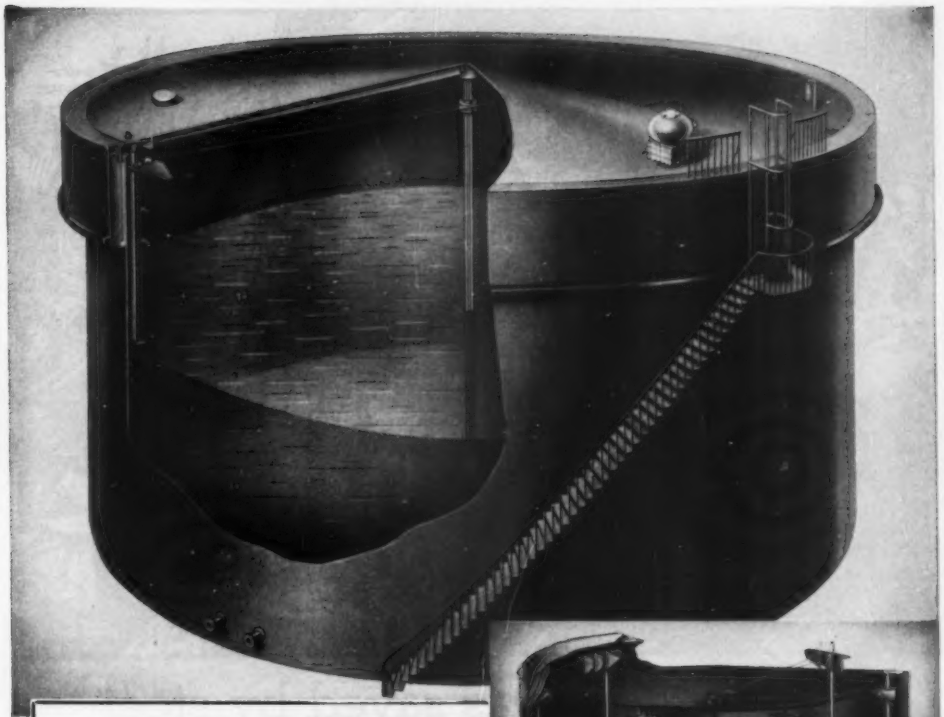
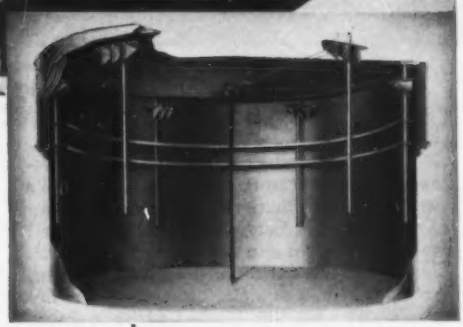


INSIDE STORY

ON VAPOR-SAVING WITH THE GRAVER EXPANSION ROOF

Cut-away for your inspection is this Graver Expansion Roof Tank. Here you see the details of its operation which dependably conserves the volatile elements of gasoline . . . so critically important today! This Graver design—approved by Underwriters' Laboratories—has a record of unfailing operation throughout the petroleum industry during the decade since it was first introduced.



Inset above shows mechanism by which *all-weather* stability is attained in the Graver Expansion Roof. The functional perfection of this design keeps *Conservation at Work* day and night in any climate . . . all year 'round.

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ALL day long, waves of Arab horsemen beat upon the ranks of Charles Martel's veteran militia. But time after time, the enemy cavalry recoiled before storms of iron-tipped javelins, their shining scimitars unsuccessful. On the second morning, the Saracen leader, Abderrahman, was slain, pierced with many spears. The Moslem horde fled back across the Pyrenees, never again to menace the Western world.

Time after time, as at Tours in 732 A.D., Christian civilization has been threatened by seemingly invincible enemies. Yet history proves that victory invariably has gone to the nation or alliance which excelled in the production and use of iron and steel.

In the present era of alarms and crises, it is reassuring to realize that America has greater capacity for making steel than all the rest of the world combined. Furthermore, the American steel industry is expanding at a rate far faster than that of all the dictator-directed economies behind the Iron Curtain. Our free and independent steel making and metal working industries can and will forge sinews for the peace we want or for the war we may be forced to fight.

So remember this: It is not only the threat of Muscovy to fear—America has itself to fear also—its misguided sentimentalists, its sheltered saboteurs—who seem to play communism's game by frittering away our strength and our resources.

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works for the Petroleum Refining Industry

● McKee maintains *separate* engineering staffs for designing petroleum refineries and iron and steel plants, and *joint* staffs for purchasing, procurement, expediting, construction, supervision and inspection. This large organization enables us to undertake projects of any size entirely *within our own organization.*

During 1950 McKee engineering activities included the projects listed below. Under the McKee method of operation this organization accepted undivided responsibility for each of the contracts undertaken. This method eliminates multiple sub-contracts, duplication of effort, delays and unnecessary expense. McKee engineering means your new plant is in production—your capital investment making profits—at an earlier date.

BOGOTA, COLOMBIA. Completely integrated steel plant including coke plant, blast furnace, basic Bessemer steel-making facilities, rolling mills, power house and auxiliary facilities. Design and engineering now in progress.

BORDEAUX, FRANCE. Rebuilding and enlarging war-devasted refinery. Construction of new atmospheric crude distillation unit with a capacity of 14,000 barrels per day. Reconstruction of thermal reforming unit. Now in operation.

BRADDOCK, PENNSYLVANIA. New sintering plant. Capacity 1500 tons per day. Now in operation.

BROWNSVILLE, TEXAS. Synthetic gasoline plant for producing synthetic gasoline and chemicals from natural gas. Capacity 70,000,000 cubic feet of gas per day. Construction completed.

CARTAGENA, SPAIN. Engineering of 7,500 barrel reforming unit and polymerization unit. Design and engineering now in progress.

CLEVELAND, OHIO. Two atmospheric and two vacuum crude distillation units. Combined capacity 45,000 barrels per day. Under construction.

EAST CHICAGO, ILLINOIS. Vacuum distillation unit. Capacity 20,000 barrels per day. Design and engineering now in progress.

INDIANA HARBOR, INDIANA. Completely new open-hearth shop consisting of four 250-ton furnaces and all necessary auxiliary facilities. Now under construction.

LIMA, OHIO. Fluid catalytic cracking unit. Capacity 20,000 barrels per day. Now operating.

LOS ANGELES, CALIFORNIA. Catalytic cracking unit and related facilities. Capacity 21,000 barrels per day. Design and engineering now in progress.

MONTREAL, CANADA. Catalytic cracking unit and feed preparation facilities. Capacity 10,000 barrels per day. Construction completed. Now in initial operation.

PITTSBURGH, PENNSYLVANIA. New sintering plant. Capacity 1500 tons per day. Now in operation.

POZA RICA, MEXICO. Seven new petroleum processing units and necessary steam and power facilities. Now in partial operation. Balance of construction nearing completion.

ROTTERDAM, HOLLAND. Complete refinery consisting of nine processing units, power plant and auxiliary facilities. Capacity 22,500 barrels per day. Now in operation.

SALAMANCA, MEXICO. Complete refinery consisting of six processing units and auxiliary facilities. Capacity 30,000 barrels per day. Now in operation.

Other miscellaneous projects in various locations in Mexico.

SAULT STE. MARIE, CANADA. New sintering plant. Capacity 1,350 tons per day. Design and engineering now in progress.

SHOTTEN, ENGLAND. New 1400-ton blast furnace. Now under construction.

VIRGINIA, MINNESOTA. New sintering and nodulizing plant. Capacity 1,500 tons of sinter and 1,000 tons of nodules per day. Now under construction.

VOLTA REDONDA, BRAZIL. Expansion of integrated steel plant previously engineered by McKee. New construction includes additions to coke plant and open-hearth facilities, new blast furnace and increased finishing capacity. Design and engineering now in progress.

WILMINGTON, NORTH CAROLINA. Asphalt redistillation unit. Capacity 3,000 barrels per day. Construction completed.

NOT YET ANNOUNCED: Contracts for three new blast furnaces have been undertaken by Arthur G. McKee & Company. Combined capacity will exceed 4,000 tons per day. Design and engineering is now in progress.

In addition to the major projects listed above, McKee engineering activities for 1950 included some 50 miscellaneous iron and steel plant and petroleum refinery projects in the United States and foreign countries.

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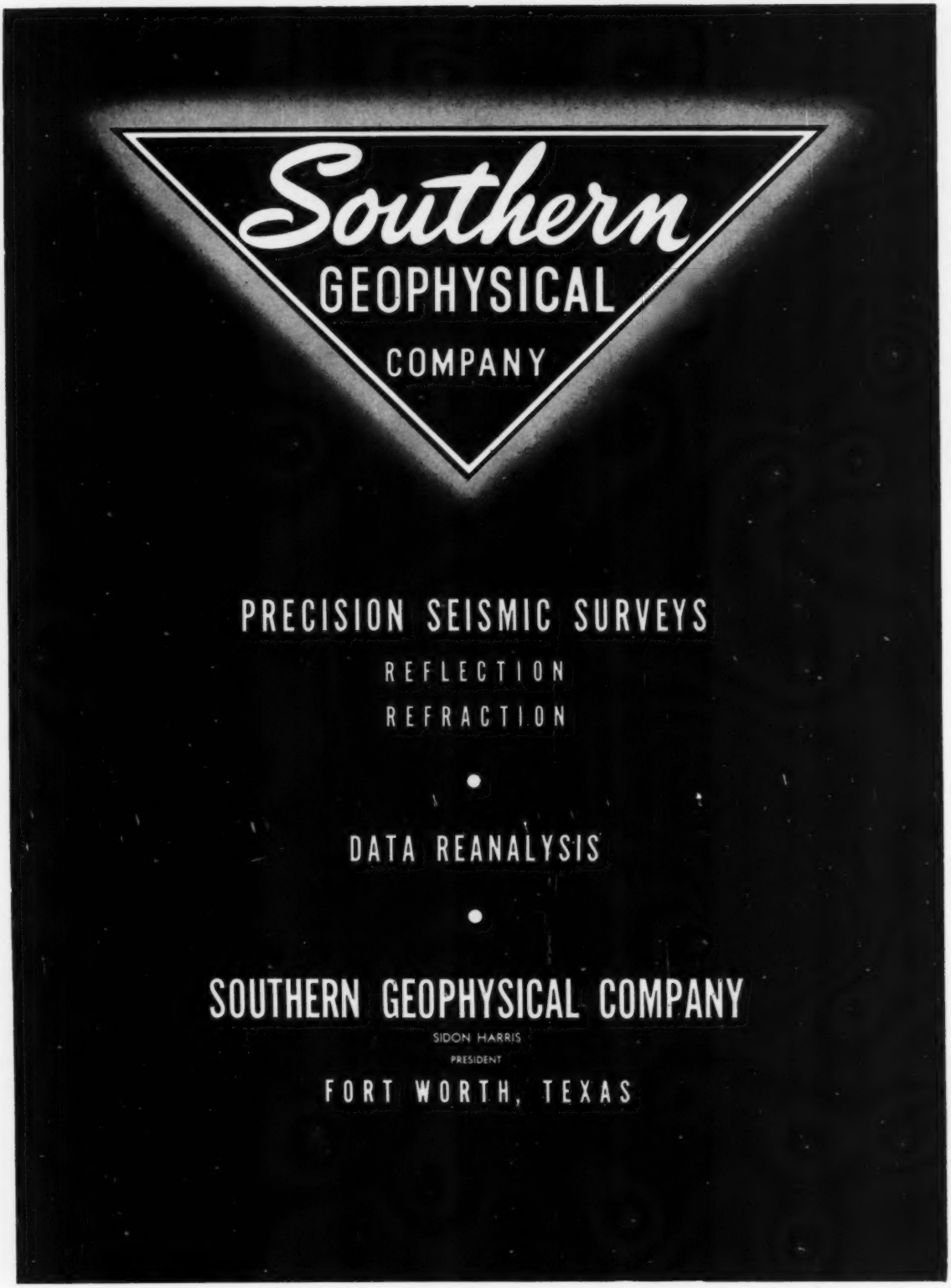
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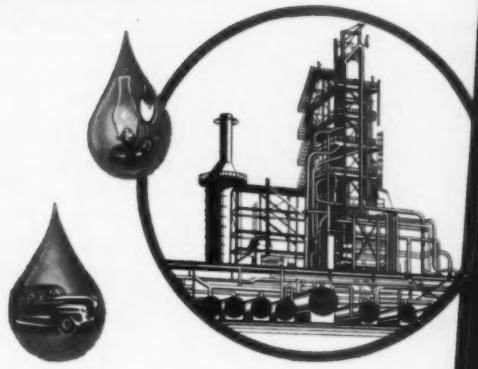

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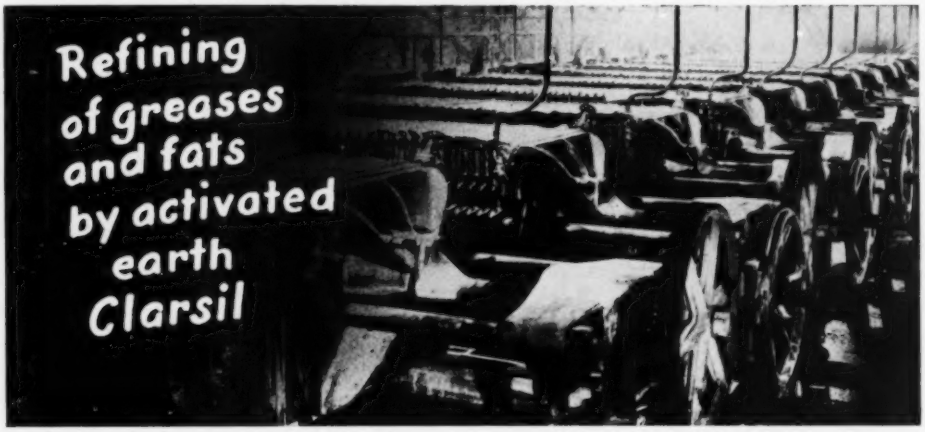

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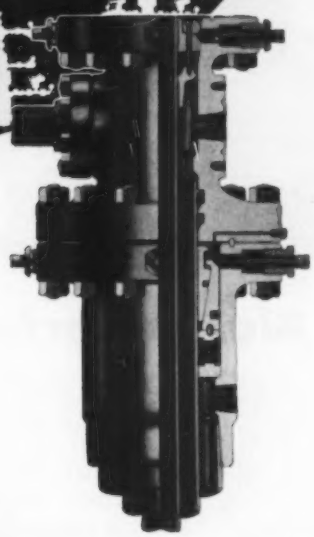

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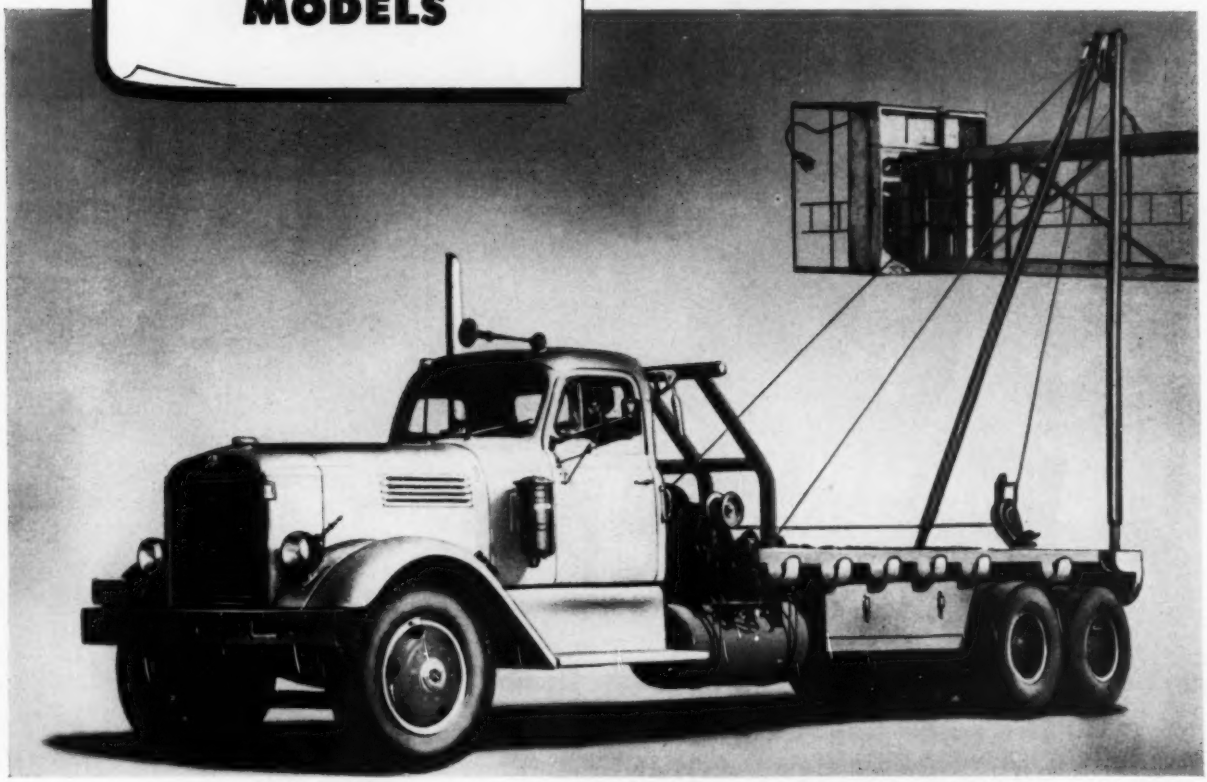

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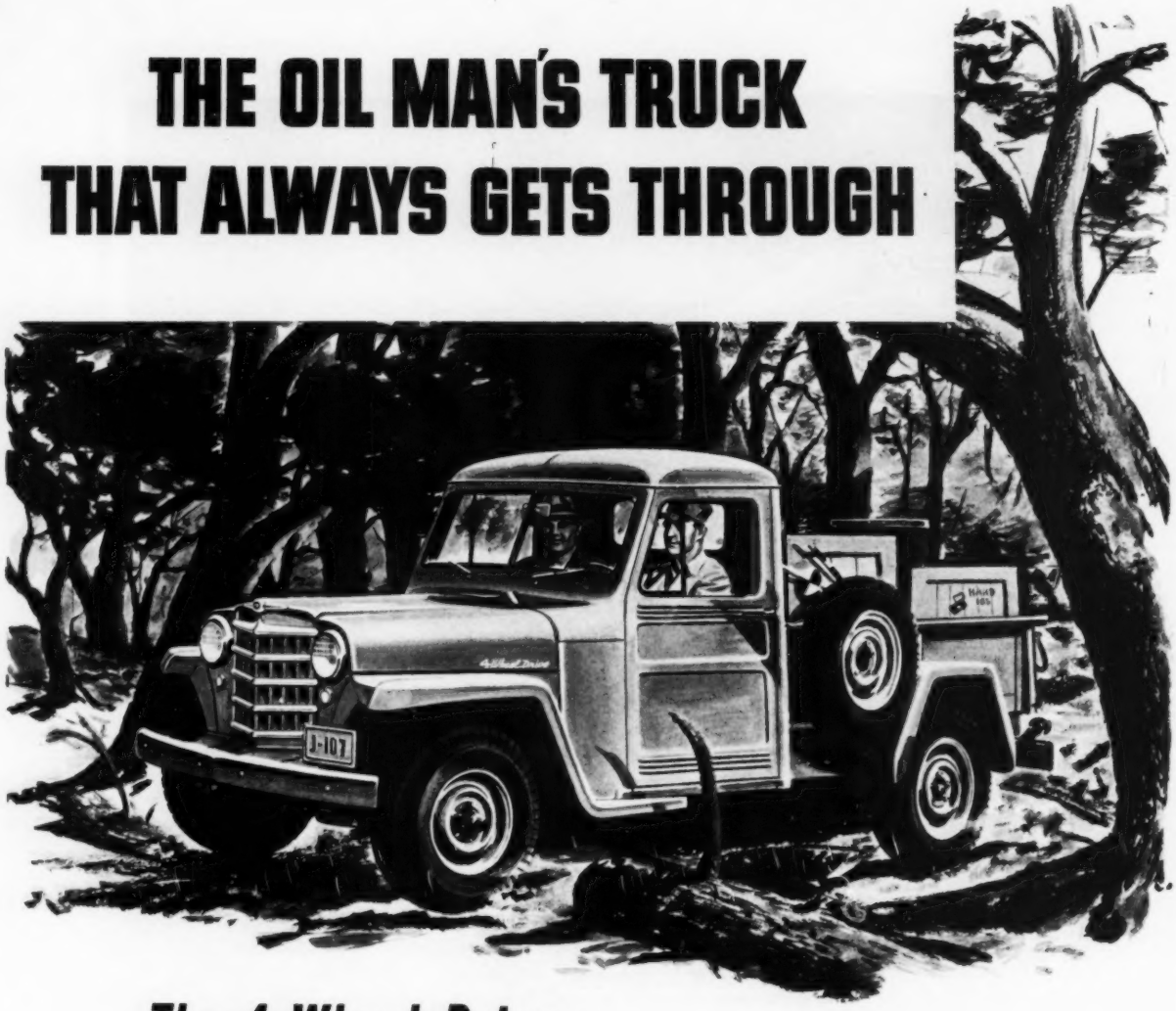

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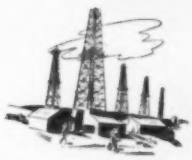

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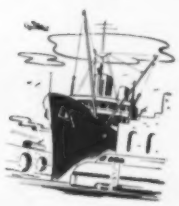
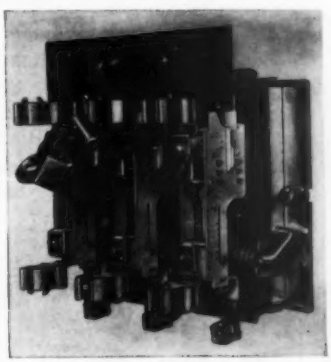


Type C Industrial & Entrance Switches applicable as motor circuit disconnects, motor controllers, individual units on heating installations (see TEC-307A);

Type D Enclosed Switches for residential, commercial and farm applications (see TEC-1).



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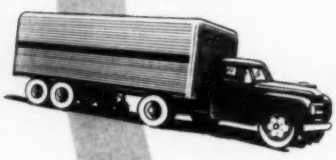

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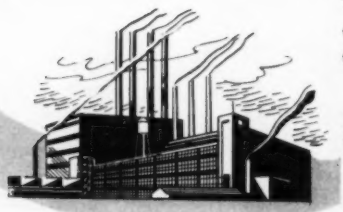

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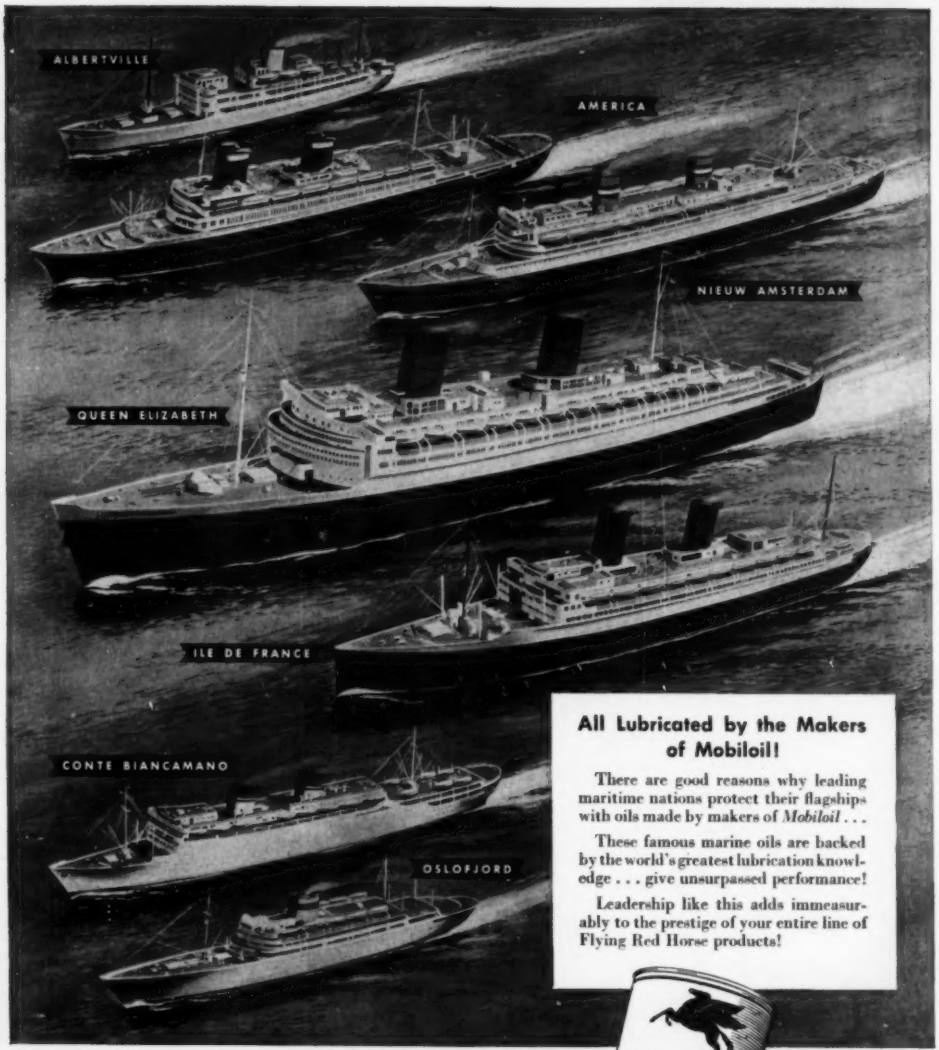

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This Month's Cover

The driller on Kerr McGee's Cameron No. 1 is standing on a man-made island off the Louisiana coast of Mexico. Kerr McGee Oil Industries, Inc., leased four adjoining blocks totaling 20,000 acres of submerged land adjacent to Cameron parish at a bonus cost of $400,000 before starting this test. Photograph is by Robert Yarnall Richie and color plates are reproduced through the courtesy of Dresser Industries, Inc.

World Petroleum Index

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Editorial

No Tax Should Be Put on National Security

THE Petroleum Administration for Defense has been fortunate in its passage through the preliminary skirmishing that seems always to characterize a real or imagined emergency in Washington, due largely to the firm position taken by Interior Secretary Chapman and his readiness to give consideration to the views of men whose knowledge of the oil industry is fortified by past experience in working closely in collaboration with government officials. By his order of Jan. 29, the Secretary transferred to PAD wide authority, giving it virtually a free hand in regard to the production, distribution and use of petroleum products, the allocation of materials and the employment of manufacturing facilities. This is a highly encouraging step, both psychologically and for the attainment of practical results, supported as it is by the tested ability of the staff which Deputy Administrator Brown is assembling.

The task devolving upon the oil industry is a tremendous one since the success of the preparedness program depends upon stepping-up industrial production which in itself demands increased consumption of liquid fuels and since the emphasis in rearmament is being placed upon the rapid multiplication of machines and accessories that are useless without abundant supplies of a wide range of petroleum products. That the job will be done we may be sure providing the efficiency of the industry is not impaired by acts and regulations over which the Petroleum Administration has no control.

Efforts to impose such handicaps are to be expected. One such is already taking form in connection with the troublesome problem of taxation to which Congress is now directing its attention. In his message on this subject early in February the President, referring to conditions requiring remedial measures, included among these "the gross under-taxation of the oil and mining industries." Although he did not particularize the Secretary of the Treasury has since explained to the Congressional committee charged with formulation of the tax bill the specific nature of the projected changes. These include a reduction in the rate of depletion allowed on oil properties calculated to add $400,000,000 yearly to federal revenues and a doubling of the present tax on gasoline which is counted upon for $600,000,000. Thus oil is expected to provide, in addition to its present tax load, one billion out of the sixteen billion of additional revenue, that is being sought. A sales tax if adopted would fall upon the heavily burdened shoulders of the consumer and should be judged from that viewpoint, but removal or drastic reduction of the depletion allowance would strike at the very roots of the oil industry and would work against the replacement and possible enlargement of reserves on which the future effectiveness if not the very existence of the industry depends.

The reason for a depletion allowance is simple and easy to understand. The operator of an oil well deals with a wasting asset. Every barrel of crude that he brings to the surface means one barrel less remaining to be recovered. In other words, he is disposing of his capital and a tax upon capital violates both the spirit and the letter of the income tax laws. The only way in which the producer of oil can continue in business is by constantly maintaining a search for new deposits which requires the investment of new capital or the reemployment of that which has been preserved under the law.

Various schemes for fixing a fair depletion allowance have been proposed and tried in the past but all have proved cumbersome and difficult to administer equitably. The plan of a percentage rate now in effect was fixed upon after thorough study as the fairest and most simple to apply; it was adopted by Congress in 1926. The rate of 27½ percent then established was a compromise between bills passed by the two branches of the national legislature. The Senate proposed a rate of 30 percent while the House provided for one of 25 percent and in conference the median figure was adopted.

This rate has remained unchanged through a quarter century down to the present time. Under it the production and consumption of petroleum has tripled and the volume of known reserves, the only basis for future operations, has similarly increased. By protecting capital values it has enabled the industry to provide billions of dollars to find the oil required to serve national needs. By all accepted tests the provision has worked fairly and effectively. With demand active and prices rising exploration has been encouraged and reserves have been correspondingly enlarged. With slack demand and lowered prices the tempo of exploratory work has been reduced and with it the depletion charge.

Like practically all other costs the expenditure required to find new oil deposits has rapidly mounted in recent years. Not only have wages, materials and equipment risen greatly in price but the amount of oil made available by a successful drilling test has progressively declined. Drilling statistics show that as recently as 1948 each productive well added approximately 100,000 barrels to the recoverable supply while in 1949 the average was roundly 95,000 barrels and in 1950 it fell below 90,000. It is common knowledge that the number of major fields discovered is becoming smaller year by year.

At a time when the need for intensified exploration to enlarge available supplies is more urgent than ever before and when oil is vitally necessary in the drive to assure national security it would be short sighted policy and indeed a threat to security itself to discourage the replacement of those underground stocks that are being so heavily drawn upon.

Discovery Rate Well Maintained

Wildcatting and development drilling at new high levels in 1950 met growing oil demand and added substantially to known reserves.

THE domestic oil industry in the United States produced 2,153 million barrels of liquid petroleum in 1950 and added about 1,600 million barrels to known liquid underground reserves*. Discoveries through wildcatting and extension of known fields thus approximated 3,750 million barrels during the year or about forty percent in excess of consumption. This was accomplished by the drilling of about 42,000 wells exclusive of input and other service wells.

Known reserves of recoverable oil in the United States on Dec. 31, 1950, were on the order of 30,000 million barrels or 13.9 years supply at the 1950 rate of production. Based on total domestic demand the known reserves were equal to 12.7 years supply. A year previously known reserves at 28,378 million barrels were equal to 13.4 years supply at the 1949 rate of domestic consumption and on Dec. 31, 1948, reserves were equal to 12.7 year's supply. For the past three years, therefore, the domestic industry has found enough new oil to keep the nation's known reserves rising at about the same rate as demand has risen.

Recently there has been a good deal of discussion among oil experts as to how much oil remains to be discovered in the world and particularly in the United States which has been drawing on its resources faster than any other section of the globe. In recent years the tendency has been to place United States ultimate reserves at around 110,000 million barrels.

Writing in the January issue of the journal of the American Institute of Mining and Metallurgical Engineers, E. DeGolyer offers the opinion that the estimate appears too low in view of the rate at which we are finding new oil. Thus far the United States has produced 41,000 million barrels and has known producable reserves of 30,000 million barrels, leaving only some 40,000 million barrels remaining to be found, according to the above calculation. "If we are prospecting for the last third of our total oil resources . . . there is nothing in our present very satisfactory discovery rate to indicate that we are approaching the bottom of the barrel. There should be if this were true," Mr. DeGolyer wrote.

For 1951 the industry has been tentatively assured of enough steel to drill 44,000 wells. Assuming that 1,200 service wells will be required this will leave 42,800 to be drilled for oil and gas, about 800 more than in 1950.

The United States Bureau of Mines has estimated domestic demand for petroleum in 1951 at 2,527 million barrels, an increase of 171 million barrels or 7.3 percent over 1950. Some students of the industry are inclined to place the increase a bit lower, on the order of six percent. Bureau of Mines estimate of net imports for 1951 is 254 million barrels. On this basis a production of 2,273 million barrels of petroleum liquids will be required to prevent a reduction in above-ground storage. The Bureau figures that exports will decline sharply and imports increase with the result that an increase in domestic crude production of only 120 million barrels or 5.6 percent will be required.

In recent years each new well drilled for oil and gas has increased the apparent oil supply by a diminishing amount. In 1950, for example, 42,000 wells were drilled and new production plus additions to reserves totaled 3,750 million barrels, an average of 89,500 barrels per new well. In the previous year 37,633 wells drilled for oil and gas increased the visible supply of oil 3,554 million barrels or 94,500 barrels. In 1948 each new well was worth 100,000 barrels of new oil.

If the trend of the past three years continues in 1951, each new well drilled for oil and gas will increase the visible supply by about 85,000 barrels. A drilling program of 42,800 wells would provide the demand of 2,273 million barrels and increase known underground reserves by an additional 1,365 million barrels. Known reserves at the end of the year of about 31,400 million barrels would represent about 12.4 years supply at the 1951 rate of discovery.

This may, of course, be leaning too heavily on the law of averages. It is conceivable that the rate of discovery might take a sudden slump. On the other hand, if state regulatory agencies should restrict drilling of development wells to 40 acres or some such wide spacing pattern the discovery rate due to extension of known fields might increase quite sharply. The latter possibility seems more likely than the former. The Petroleum Administration for Defense appears to have adopted the policy of leaving spacing and similar regulations to the various states, but it has pointed out to members of the Interstate Oil Compact Commission that thought should be given to methods which will conserve steel.

Any restriction on well spacing in the step-out development of known fields would permit, of course, the drilling of additional wildcats without exceeding the planned number of wells. In 1950 the industry drilled about 8,500 wildcats as compared with 7,300 in 1949. This was a new record number of exploratory drilling projects. The success ratio was about the same as in recent years, with 15 percent finding oil, three percent gas and 82 percent being dry.

The outbreak of hostilities in Korea exerted a marked effect on wildcat drilling in the United States in 1950. Exploratory wells completed in the last half of the year were 20 percent greater than in the first half. In the last half of the year wildcat drilling was at an annual rate of about 9,500 wells. This compares with 7,250 in 1949. At the moment it seems likely that wildcat drilling will continue through 1951 at not less than the rate reached in recent months and so produce a new record for exploration.

Wildcat drilling often follows the trend of geophysical activity after a time lag adequate to evaluate records accumulated by field crews. On this basis there should be a considerable increase in wildcatting in 1951.

In the first quarter of 1950 there were about 350 seismograph parties in the field in the United States. The second quarter saw an increase of nearly ten percent to about 380. In the third quarter the average was above 400 and in the last quarter the number was about 415. Increase as between January and November was 16.5 percent.

Development drilling in 1950 was exceedingly active in the reef fields of West Texas. In West and West Central Texas more than 7,000 wells were drilled last year, about a sixth of all wells drilled for oil and gas in the United States. Of these about 5,600 were development wells. Much of this development work centered in the Scurry County area where it may not be necessary to drill so many new wells in 1951. There were, however, 250 new discoveries in this area and these will require a considerable amount of development drilling. With nearly a third of the 1950 drilling and almost half of the year's crop of discoveries Texas clearly retained its right to brag. It must yield only in depth records since four other states have had deeper dry holes and three others have deeper producing wells. Oklahoma, Kansas and Louisiana all had an active wildcatting and development drilling year with good results.

On the north, Canada has continued its spectacular drilling campaign. Geophysical activity also has continued to increase during the past year. At the end of 1949 there were 81 seismograph crews operating in the Dominion. At the end of 1950 the number was 108, an increase of 33.4 percent. Although the pipe line outlet to the east was not complete and new wells had to be deeply prorated in Canada the industry continued its drilling activity at a rate about 37 percent greater than in 1949 and nearly double that of 1948. With the Interprovincial line delivering crude to the Great Lakes in 1951 it is anticipated that drilling will show another substantial increase this year. As the second largest per capita consumer of petroleum in the world Canada is anxious to develop its oil resources to the point where it will not be dependent on foreign sources as always has been the case in the past. Even at its peak production rate of about 100,000 barrels of oil daily

(*Please turn to page 81*)

* Official estimates on reserves had not been compiled by the special committee of the American Petroleum Institute charged with this task at the time this was written. The reserve figures cited are estimates of a number of oil company economists. Official figures will be published within the next month.

WASHINGTON

PAD Receives Full Authority Over Oil Industry Operation

By Joseph B. Huttlinger

THE question of who in the Interior Department runs petroleum and gas matters has been settled finally in favor of the Petroleum Administration for Defense. Despite proposals to divide its functions with other bureaus its organization will parallel that of the Petroleum Administration for War during World War II with Secretary of the Interior Oscar L. Chapman as administrator and Bruce K. Brown, deputy administrator and, for all practical purposes, the real director. Their titles and authority correspond with those of Secretary Ickes and Ralph K. Davies in the set up of PAW.

Under an executive order signed by Secretary Chapman Jan. 29, Mr. Brown is empowered to exercise all oil and gas functions vested in the Interior Department under the current mobilization legislation, subject to the "direction and control" only of Chapman. He is to operate "separately from, independently of and outside the jurisdiction or authority of any officer or employee of the Department of the Interior except the Secretary."

The virtual wartime powers now in the hands of the PAD spring originally from legislation enacted by Congress last September giving President Truman wide authority over the whole national economy. In turn, the President delegated his functions, so far as they relate to oil, gas and pipe lines, to Secretary Chapman. Now Chapman has passed on to Brown the oil, gas and pipe line functions. Thus the arrangement advocated by the oil industry has emerged from the confusions of delegations and redelegations that prevailed for a time and the pattern now appears set.

While other agencies have jurisdiction over price, wage and consumer rationing controls, applicable to oil and gas as to other products, PAD will be the chief contact between the industry and the government in the period ahead.

Reserved specifically to Secretary Chapman, is the power to name dollar-a-year men, or, as the saying is today, men serving "without compensation," to PAD positions. About a score of such persons have joined PAD, the chief example of which is Brown himself, who may receive a salary from Pan-Am Southern Corp., subsidiary of Standard Oil Co. of Indiana, of which he has been president.

While PAD handles industry operations and is charged specifically with providing the products required by the preparedness program, other agencies exercise powers that may affect oil and gas along with other products. The Economic Stabilization authority for instance, is authorized by the legislation of last September to handle price and wage controls and consumer rationing, if that becomes necessary. Under its general freeze of prices and wages of Jan. 25, the agency froze crude and products prices and wages at the top level of the Dec. 19-Jan. 25 period. Next step was to set specific dollar and cents ceilings on crude oil and products and on tanker rates, which the ESA wants to roll back to about 150 percent of U. S. Maritime Commission rates. The ESA also has been trying to figure out how to price-control imports of petroleum. Best guess is that ESA will set a maximum price that importers may pay for offshore crude or products.

Business expansion, including that in the petroleum field, is aided by the Defense Production Act which allows five year tax amortization on certain construction. But advance approval is needed, and the final word on such approval rests with the Defense Production Administration. In actual practice, the DPA relies heavily upon the PAD for advice on petroleum facilities, but it must take the responsibility for its decisions. A sign invoking confidence of the petroleum industry lies in the fact that DPA has brought in Don Carroll, a petroleum geologist who worked for the Oil and Gas Division and PAD of Interior and with the Economic Cooperation Administration in Korea to handle petroleum tax amortization requests.

A limited amount of government equity capital is available for certain projects of importance to national defense, which would not otherwise be constructed, but this is in the domain of the Reconstruction Finance Corp. In practice, the RFC will turn to the PAD for advice on any applications for loans from petroleum companies, but it need not be bound by PAD's opinion.

The National Production Authority is an agency with tremendous powers. It has authority over a broad variety of industries identical to those held by the PAD over the oil and gas industry. In steel, for instance, the NPA parcels out the available supply to the various claimant agencies, including PAD, which then distributes it equitably among oil producers, refiners, pipe line builders and the like. It is with the NPA, in fact, that the PAD has been having its first, early troubles.

The PAD has been asking ever since last year for 1.8 million tons of steel to drill about 44,000 wells in the United States, and a substantial number abroad. The NPA constantly has delayed making a decision. And even when top and bottom level officials at NPA agreed that oil producers must have the steel they ask, there continued to be delay. The NPA, further, has sought to handle foreign oil matters. So has the PAD. This question can be settled only by climbing the chain of command for a top level decision. The direction of the mobilization program shapes up like this:

(1) Office of Defense Mobilization is top dog. It handles overall direction and coordination. Director is Charles E. Wilson who left General Electric Co. to take the post.

(2) Defense Production Administration is next. It handles overall production programming. Director is William H. Harrison, a telephone company executive.

Then come the various other agencies. There is the ESA on price, wage and rationing controls; Agriculture Department on agricultural matters; Interior on coal, minerals, oil and gas, electric power; the National Production Authority on nearly everything else.

While PAD now operates under a definite, satisfactory pattern, that state was not achieved easily. From the start things went wrong. First of all, Secretary Chapman created a Minerals and Energy Administration to handle oil, gas, coal, electric power and minerals. Several non-oil agencies were given veto powers over decisions of the oil section. Oil men objected bitterly, and the Secretary said he would change the arrangement. On Oct. 4, he did, creating PAD as a separate agency, directly under him. On Jan. 4, however, President Truman issued an executive order taking back all the powers Secretary Chapman ever had and giving them to the Defense Production Administration. There was an understanding that the powers would be redelegated to Secretary Chapman, but that did not occur until Jan. 24. Even then, it was not clear that the PAD would be its own boss in the Interior Department until the Chapman executive order of Jan. 29 giving PAD's deputy director, Bruce K. Brown, the full authority needed for handling his specific job.

There has been confusion, and there will be more of it. Some of it has been serious and some less so. Thus, Secretary Chapman created the Defense Power Administration, which became the DPA. But President Truman created the Defense Production Administration, which has the same initials. To clear the alphabetical complication Chapman had to rename his agency Defense Electrical Power Administration.

PAD's organization as thus far completed, with division heads, includes the following:

Oscar L. Chapman, Secretary of the Interior, administrator of the Petroleum Administration for Defense.

Bruce K. Brown, deputy administrator of the Petroleum Administration for Defense. He is president, Pan-Am Southern Corp., New Orleans, a Standard Oil Company of Indiana subsidiary.

Carroll D. Fentress, special assistant to the deputy administrator. He has been associated with the Oil and Gas Division of Interior for several years.

Hugh A. Stewart, assistant deputy administrator of PAD and director of the Oil and Gas Division of the Interior Department. He was Texaco's Rocky Mountain manager.

A. P. Frame, assistant deputy administrator of PAD for domestic operations, a vice president of Cities Service Oil Co.

C. S. Snodgrass, assistant deputy administrator of PAD for foreign operations, executive vice president of Bechtel International Corp.

(*Please turn to page 81*)

Exploring For Pennsylvanian Reef Reserves In West Texas

By Sidon Harris[1]

SUN'S discovery of the Jameson Area in Coke County, West Texas, a few years ago kicked off perhaps one of the most interesting recent plays in the Southwest if not in the entire Mid-Continent. A little over two years ago the very prolific reef discovery of the North Snyder field by the Standard Oil Co. of Texas in Scurry County augmented this play considerably. Of course, prior to the discovery of the North Snyder, the Diamond M field of western Scurry County had been discovered. During the past two years Scurry County has become almost a second "East Texas" from the standpoint of activity and estimated potentials of proven reserves. Within the past few years a number of other potentially significant fields have been discovered in Howard and Borden counties lying west of Scurry County. The more prominent of these fields include the Vealmoor, East Vealmoor, Reinecke, Goode and others.

The first indication of reef production in Terry County lying to the north and west of Borden County was obtained over two years ago by Seaboard Oil at Mound Lake. However, this field did not appear to be highly prolific at the time of its discovery. Within the past six months, however, the discovery of the Wellman field of south central Terry County by the Anderson-Prichard Oil Corp. followed very closely by the discovery of the South Brownfield pool by the Union Oil Co. has focused considerable interest in this immediate area from the standpoint of potential reef production of considerable magnitude. Interest in these possibilities was further emphasized during 1950 by the discovery of the Ropes reef production in southeastern Hockley County by the Honolulu Oil Co. and associates.

Thus it seems that exploration during the past few years has defined a broad reef trend or zone extending from the Jameson area at the southeast in a generally northwest direction through parts of Mitchell, Howard, Scurry, Borden, Garza, Kent, Lynn, Lubbock, Terry and Hockley counties. Also within the past four years the discovery of the Round Top and Pardue reef pools in Fisher County directed interest to reef production on the western slope of the Bend Arch province which forms the eastern flank of the Permian Basin of West Texas.

The rather high recovery per acre and thick pay sections indicated by the above mentioned discoveries have focused attention on this type of anomaly which presents rather difficult problems to geologists and geophysicists.

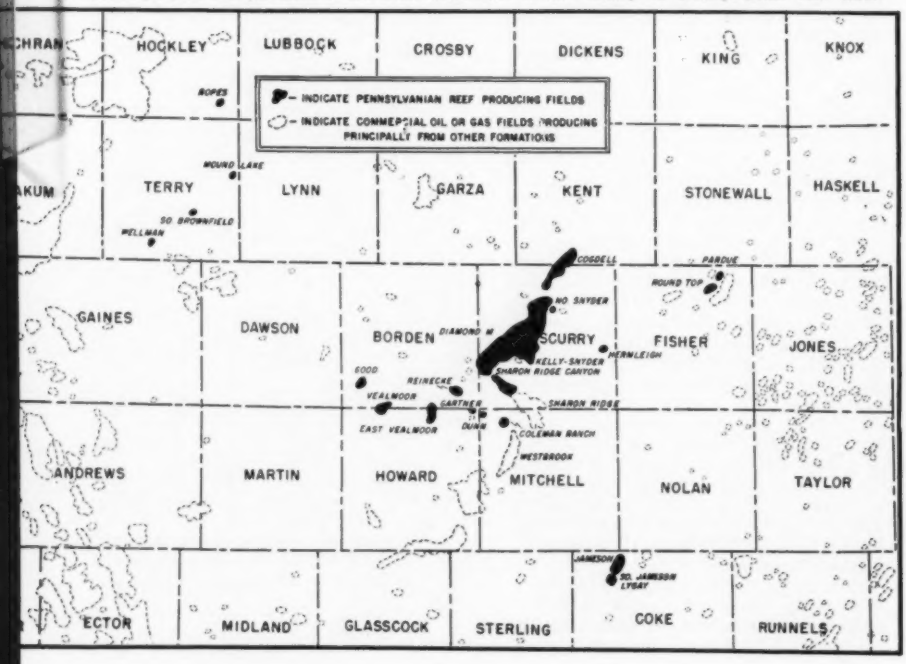
Very little reflection of the Pennsylvanian reef is indicated in the overlying Permian section in this province. This fact is illustrated by the generalized geological cross-section taken across the North Snyder area shown in Figure 1. Attention is called to the fact that very little if any relief is indicated on the overlying beds through the top of the Black Shale section. This means that core drilling is of practically no value in searching for these Pennsylvanian reefs. Likewise, any method that merely maps the Permian is of no particular value. It is essential to obtain reflections from the Pre-Permian in order to detect the possibility of the presence of Pennsylvanian reefs. Very sharp dips on the flanks of the reef of more than 500 feet in one well location merely tends to accentuate the problem.

A very good technical paper by Fred Agnich* was recently published in Geophysics which described several techniques and methods of identification of possible reef conditions by use of reflection and refraction seismograph.

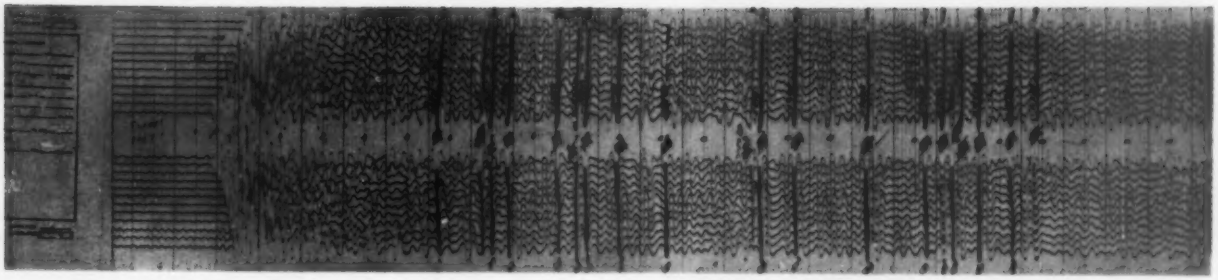
In general, there is no "mystic" method or procedure for detecting the possibility of Pennsylvanian reefs. A good many of the above mentioned reef producing fields were located by means of reflection seismograph, so it can be said at least that the reflection seismic method when properly applied can detect reef formations. However, it is difficult to positively identify the existence of Pennsylvanian reefs by the seismic method before drilling. We are still faced with the obliga-

[1] President, Southern Geophysical Co., Fort Worth, Texas.

Commercial oil and gas fields in the West Texas area in the vicinity of Pennsylvanian reef fields.



* "Geophysical Exploration for Limestone Reefs", by Fred J. Agnich, published in Volume XIV, Number 4, Oct. 1949 issue, Geophysics.



Seismic reflection profile from the survey leading to the discovery of Anderson-Pritchard No. 1 Bevers, Wellman field, Terry County, Texas.

tion of drilling any closed anomaly based on fairly reliable seismic data. Fortunately, we have the advantage of possible production as a result of structure even if the "closed high" is not a reef.

If one can set forth certain rules for properly exploring for the Pennsylvanian reefs in West Texas, they might be as follows:

(1) Employ up-to-date, modern seismic instruments with a very flexible response reaction.

(2) Be careful of too much "mixing" or "overlapping" of detectors.

(3) Do not disregard sudden sharp or "screwy" dips which apparently do not conform with the rest of the section, both above and below the dip involved.

(4) Carefully pick and plot on the seismic cross-section all dips that appear to be valid reflections regardless of magnitude or direction of the dip. The synthetic cross-section illustrated in Figure 2 may be regarded as a typical section obtained from shooting across a prominent Pennsylvanian reef. Very rarely is a continuous reflection obtained across the top of the so-called reef. The seismic map has to be made by running a "phantom" horizon in the zone of the reef, prepared by paralleling dips. A rather intensive shooting pattern should be used, running lines forming a grid of one mile squares.

(5) Too little shooting probably is worse than none at all. Areas that exhibit the possibility of a deep-seated Pennsylvanian anomaly should be thoroughly explored, sometimes even cutting a section of land with several crisscross lines.

(6) And last but not least, all data should be thoroughly worked and rechecked.

In attempting to decide whether the seismic closed anomaly at Pre-Permian levels is a reef or merely a deep-seated structure, the interpreter can be benefited by several characteristic tendencies. In most cases some reflections will be obtained from the sides of the reef formations which will appear as rather steep dips and perhaps in a somewhat erratic manner. These dips in general will be steeper than dips above and below. Sometimes an absence of reflections will be noted through the core or center of the reef. This type of typical cross-section is illustrated in Figure 2. If the feature is a deep-seated anomaly or fold, the dips should remain as steep, or become steeper with depth, down to the anticipated basement complex.

Modern seismic recording truck setting up for "shot" in West Texas.

Heavy duty rotary drill crew at work.

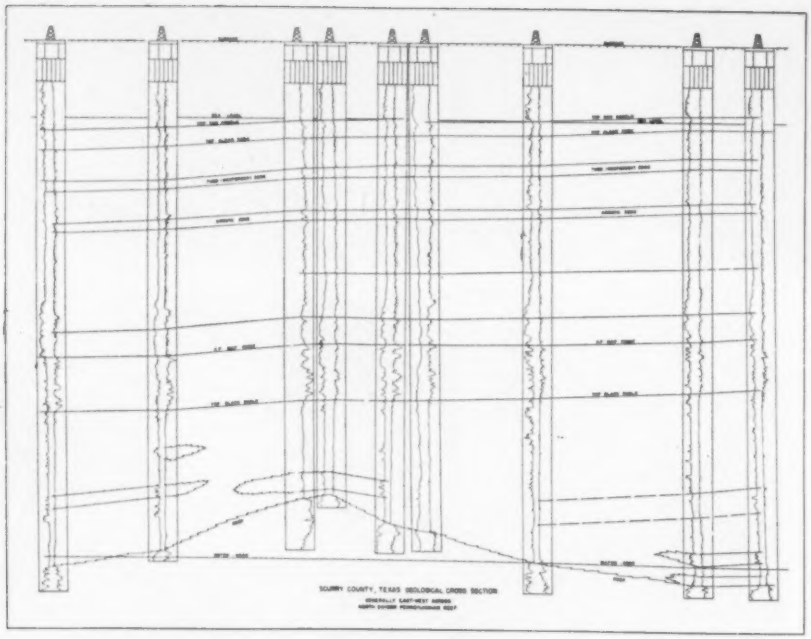
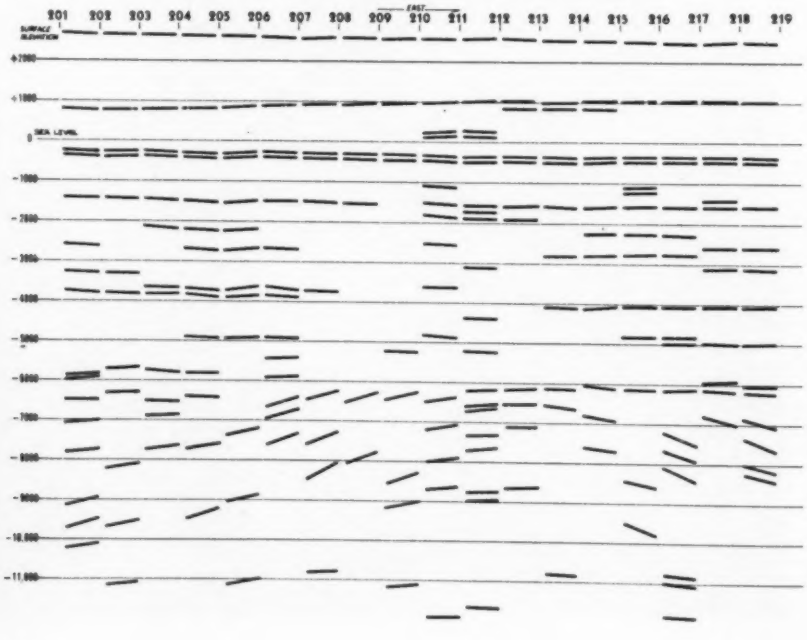


Fig. 1. Scurry County, Texas, geological cross section generally east-west across North Snyder Pennsylvanian reef.

In some cases the velocity of the seismic waves through the reef itself is considerably faster than the surrounding media, which will tend to give a velocity anomaly; which, of course, will give fictitiously steeper dip on the formations below the reef zone, which increases the difficulty in determining whether or not the anomaly is a reef formation. I believe, however, in this case we either have a reef or a fold which, if we have source beds, should constitute at least a drillable prospect.

Fig. 2. Synthetic reflection seismograph cross section, generally typical across major Pennsylvanian reef accumulation in Permian basin of West Texas.



Finally, in summary it can be said that a reef of substantial magnitude in the Pennsylvanian zone in West Texas should exhibit an appreciable seismic closure when properly interpreted and recorded by competent instruments. However, it is extremely difficult to determine definitely in advance of the drill as to whether the indicated anomaly is a reef formation or a structure. The evidence obtained from the reflection seismic survey should be reviewed very carefully by the combination of experienced geophysicists and geologists and then at best only an opinion can be advanced. The determination of the existence of the Pennsylvanian reef by the experienced geophysicists and geologists from the analysis of available seismic data is quite analogous to the diagnosis of a competent physician made from the analysis of X-rays and other medical tests. In any event, whether the seismic "closed high" is a reef formation or an anticline, it should definitely be a drillable prospect if based on reliable data and if it has an appreciable amount of closure. This is about the only really "happy thought" with relation to this problem.

At the present time the reflection seismograph appears to be the best known means of locating Pennsylvanian reefs in West Texas. The approximate cost of maintaining an adequate crew for exploration in West Texas to the operator varies from $20,000 to $25,000 a month including supplies, equipment, personnel, permits and other incidental operating expenses. On the average a well equipped, competent crew should cover 30 to 40 miles of continuous profiling per month, which for a general reconnaissance program with a fair amount of detail should cover about that many sections; giving an approximate cost of one dollar per acre for generalized exploration. Of course, in the event a good lead is indicated, the shooting cost may go as high as two dollars per acre. It is very difficult to isolate probable areas to explore since old shallow wells do not reflect to any appreciable degree the existence of Pennsylvanian reef deposits. However, the very prolific pay sections discovered in the fields mentioned earlier appear to justify the expenditure of considerable funds in attempting to locate the existence of these features. At the present time a large number of seismic crews operating for various companies are banging away along the east flank of the Permian Basin and extending out to the center of the Basin in Terry, Lubbock, Lynn, and Hockley counties in an effort to locate additional reefs. It can be said that some success has been obtained to date.

Some recognized geologists at the present time have the opinion that possibly a continuation of the Pennsylvanian reef formations extends across the Matador Arch which runs along the northern lines of Dickens, Crosby, Lubbock, Hockley and Cochran counties. At the present time a considerable amount of seismic exploration is in progress in what may be termed the Plainview Basin which includes in general terms most of Floyd, Hale, Lamb, Bailey, Castro, Swisher, Briscoe, Armstrong, Randall, Deaf Smith, Oldham, Potter and Carson counties.

Mast rig of the type being used by Pemex in the prolific Poza Rica field.

Pemex Plans 300 New Wells in 1951

By Art Geiger

PETROLEOS Mexicanos will drill a minimum of 300 wells, using 105 rigs, throughout this year and plans to keep 44 exploration crews working in proven and wildcat areas, Senator Antonio J. Bermudez, Pemex' general manager, told WORLD PETROLEUM'S correspondent.

Senator Bermudez said the broadened drilling program will be pressed at any cost to increase production by some 80,000 barrels a day and so meet sharply mounting domestic demands and help to pay for necessary imports.

The oil industry will have the benefit of twice as many rigs working this year over 1940 but may face temporary shortages of pipe and other supplies. Because of the armament programs in Western Europe officials doubt that barter agreements for pipe from overseas can be counted upon but hope for help from Washington in obtaining essential equipment.

At the same time, Senator Bermudez revealed that the oil industry had succeeded in raising production by 44,202 barrels a day during the past year. He said Petroleos Mexicanos ended 1950 with a record daily output of 228,000 barrels of crude and 400,000,000 cubic feet of gas. The largest gain was recorded during the final quarter when production increased from an average of 205,000 barrels a day in September to 228,000 barrels by December.

Including the less than ten tests drilled by foreign percentage-of-production contractors reports show that 196 wells were put down up to December 20 of the past year. Drilled largely in proven areas, 111 of the tests proved productive while the remaining 85 were dry or of no commercial value. Apart from these completions 57 other tests were under way on December 20.

A district-by-district breakdown of the Pemex figures discloses:

	Completions	Producers	Non-Commercial	Being Drilled
N. E. District	18	14	4	11
Tampico & N. District	40	15	25	9
S. District	84	38	46	12
Escolin & Poza Rica	27	26	1 (gas)	10
Isthmus of Tehuantepec	27	18	9	15
Totals	196	111	85	57

Comparison of average daily production in January and September of last year reveals that the major part of the 44,202-barrel-a-day increase from new wells was in the Poza Rica-Escolin field.

	January	September
N. E. District	1,911	1,878
Northern District	23,994	23,983
Southern District	24,205	23,855
Isthmus Area	18,670	18,610
Poza Rica-Escolin	114,959	137,255

Foreign operators working in Mexico under percentage-of-production agreements completed a total of five wells, four of them gassers and one an oil producer. These contractors have four wells going down at present.

Pemex concluded three new percentage-of-production contracts with United States companies last year. Under these agreements drillers receive about 15 percent of the production from land operations and 18 percent for off-shore drilling for 25 years, plus 50 percent of the production until the complete cost of the operation is paid. The new contracts were signed with the Sharpless Oil Co. of Denver, known in Mexico as "Sharmex," with the Isthmus Oil Co. of Amarillo, Texas, and with Edwin W. Pauley of Los Angeles, who also owns 13⅓ percent of the Cima contract signed in 1949.

Pemex has also signed a number of service contracts. They include agreements with the Halliburton Oil Well Cementing Co. of Duncan, Okla.; the Rotary Engineering Co. of Midland, Texas; the Independent Exploration Co. of Houston; and the Combustion Engineering Co. of Chicago. Negotiations with several others are currently reported to be under way.

Proposals for large-scale drilling operations by outside companies show little progress. Some that are reportedly still under discussion are those with the Southeastern Oil Co. of Jacksonville, Florida; the Texas Co.; the French Compagnie Francaise des Petroles and a few others. The main obstacle to the signing of drilling contracts is that most foreign majors will not accept the percentage-of-production plan, while Pemex is prohibited by Mexican law from offering standard-type royalty contracts.

One company that has been active in Mexico for the past two years has decided to close its offices here. This is Kermac Contractors, Inc., Mexican affiliate of the Kerr-McGee Oil Industries, Inc., of Oklahoma City. Kermac was the drilling contractor for Cima, American Independent's Mexican operation. It is believed Kermac will complete the two wells it is drilling for Cima in the Tortuguero field before pulling out. The shutdown is attributed locally to a decision of Cima to reduce its Mexican operations.

It is believed Pemex will encourage United States service companies to establish Mexican offices by offering contracts guaranteeing them enough work to make it worth while. It is considered likely that three or four independents will reach agreements with Pemex in the near future, and there is also the possibility that one major corporation may sign an overall development contract covering large areas near Reynosa in the State of Tamaulipas.

In any case, Pemex is confident of being able to complete at least 400 wells this year provided a sufficient supply of pipe is available. Enough wildcatting will be done to maintain the program of new zone development, it is stated, with the main part of the drilling centered in proven areas. These activities are counted upon to increase daily production by 80,000 barrels in 1951. The budget recently announced by Petroleos Mexicanos for the coming year totals 1,700 million pesos (approximately $196,531,790) an increase of over $40 million above that of last year. Aside from provisions for meeting the anticipated increase in consumption it calls for completion of the following projects; enlargement of the new Reynosa refinery; construction of a refinery at Salina Cruz or nearby; a desulfurizing installation at the Atzcapotzalco plant and establishment of facilities for filling trucks and tank cars; building a lubricant and paraffin plant at the Salamanca refinery; addition of a desulfurization unit to the Ciudad Madero refinery; construction of a pipe line across the Isthmus of Tehauntepec; establishment of gas distribution systems at Metamoros and other cities; installation of a 6,000-kilowatt turbo generator at Poza Rica; erection of a storage plant and tank farm on San Juan de Ulua island off the coast of Vera Cruz, and founding of a Mexican Petroleum bank for petroleum workers.

Improved Production by Hydrafrac Treatment

By Wm. D. Owsley[1]

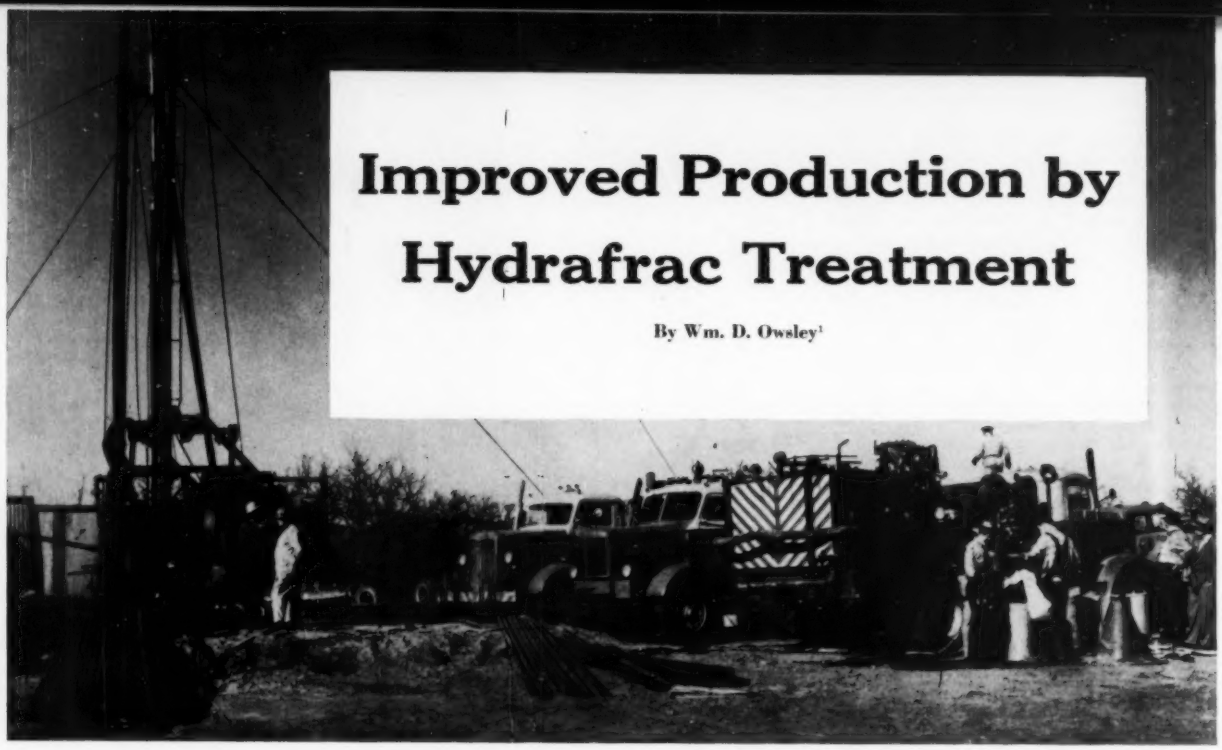


Fig. 1 Preparing an Oklahoma well for Hydrafrac treatment.

SINCE Drake's first well men have sought ways and means to increase oil and gas production from wells, ever seeking to create high initial potential, to improve rate of production from older wells, and to secure greater ultimate recovery. Many ideas have been tried and many discarded; all pointed to the goal of more oil more economically produced.

Shooting with various explosives was probably the first great increaser of well productivity. Later came acidizing procedures, primarily for limestone, which brought excellent results. Gas drive and water flooding are here to stay but can usually be applied only on an area basis. For a period of many years there were almost no really significant developments for improved initial or revived older production on a per well basis.

In late 1948 an announcement was made of methods involving the hydraulic fracturing of oil bearing formations to increase effective permeability. These procedures are now known as *"Hydrafrac" treatments. The conception of the ideas and the research behind the now established Hydrafrac processes came from the Stanolind Oil and Gas Company's research department at Tulsa, Okla.

Briefly stated, Hydrafrac methods involve the fracturing of formations by application of hydraulic pressure in excess of overburden pressure. To accomplish sufficiently high injection pressure against a formation without excessive input flow rates, a high viscosity fluid is used. Since it is usually desirable to inject aqueous fluid into oil bearing sands, a hydrocarbon was selected as the most satisfactory fracturing fluid. If a viscous fluid performed the fracturing operation and then could not be removed from the fracture, nothing would be gained; therefore, a means was worked out to gel the liquid and then cause the prepared gel to revert to low viscosity for easy outflow from the formation. It was reasoned that a fracture once produced by higher than overburden pressure would at least tend to close again when such pressure was bled away; therefore, sand is added to the gel to be carried into the fracture to assist in propping the fracture open.

In the development work gels were produced from gasoline, various other refined products, and some crudes by the use of World War II Napalm. In commercial use new and improved gelling agents have been developed which are much more suitable to the requirements of gel preparation, pumpability and break back. Reversion to low viscosity sols is accomplished by following the gel into the well with oil to which is added chemicals which cause breakdown of the gel. Chemical agents have been discovered which, added to the gels, act to prevent emulsion formation and assist in earlier breakdown, especially in low temperature wells. Kerosine is today the fluid most generally used for the gel, though some crudes are also highly satisfactory.

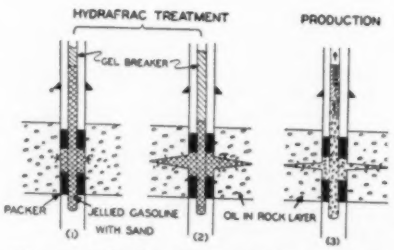


Diagram indicating how formation cracks are opened and kept open.

At conclusion of the complete injection operation the well is closed in under the final pressure existing. The usual procedure is to leave the treated well static for 25 hours or more after the job. Next, the well is recompleted by ordinary procedures. If production is not obtained by natural flow, then swabbing is recommended before applying the pump or other producing methods. No other clean-out is required. The oils used in treatment to prepare the gel, the breaker fluid and for displacement, become a part of the well's production, generally with no treating required.

Hydrafrac treatments have been applied in practically all United States oil areas with excellent success. Approximately 210 different formations have had one or more treatments. As nearly as can be checked, 75 percent of all jobs have resulted either in successful increases in production or more economical new completions than by other methods. The number of such treatments being used as an initial completion method has shown a constant increase. Wells so completed have in many instances been spectacularly successful, some giving natural flow production where previously only pumpers were being completed.

As of January 1, 1951, dating from March 17, 1949, a total of about 2,400 wells have been subjected to 2,559 Hydrafrac service treatments. It is interesting to note that these jobs were distributed among approximately 700 oil producing companies.

Well owners' thoughts on use of Hydrafrac services cover a wide range of ideas. These encompass increased production from old

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* Hydrafrac, Reg. U. S. Pat. Off.

[1] Vice President for Engineering Advice to Management, Halliburton Oil Well Cementing Co.

wells, perhaps to bring them above the lower economic limit of production; improved production from already existing good wells to improve PI and, therefore, secure greater ultimate recovery; initial completion of new wells for better production than would result from other methods, and the 'last ditch stand' in an attempt to obtain production in what might otherwise have been a dry hole. There is growing use of Hydrafrac methods to maintain and improve production in lieu of drilling new wells which are being held up by pipe shortages.

Hydrafrac treatment cannot in any sense be considered a cure for every well wherein production is lower than desired. Application of these processes should be made only after a careful evaluation of the well from available data. Many details affect the possibility of successful results.

Where and when should these methods be applied? Any sand formation known to contain oil but in which the permeability is low, especially in relation to existing bottom hole pressure, is a good prospect. Wells exhibiting very rapid declines in production but which still show good build up of bottom hole pressure under static conditions usually respond satisfactorily. Dirty or trashy sands frequently show excellent response. Some limestones which are not highly or readily acid soluble have reacted favorably to Hydrafrac treatments, especially to a combination type treatment wherein hydraulic fracturing is followed by acid injection. Surprisingly some formations having apparently high permeability have given good results, in these cases it is believed that poorly developed spots in the zone are opened to surrounding areas of better developed formation. Many wells on pinched out edges of structures have been made into excellent producers.

The nature of the formation alone is not the sole factor in considering Hydrafrac treatment and its possibility for success. It is essential that the injected fluids go where the oil is, not into an exposed shale, not up behind the casing and not into lower water. A correctly cemented casing string is essential, either where set above open hole or where perforation production methods are used. Well defined, continuous and fairly thick shale bodies must not be exposed to the treating fluids, since they are usually weaker and may take the fracture intended for the sand body. Open hole section, greater than about fifty feet, may require use of special packers to isolate relatively thinner sections for treatment. Multiple fractures in very thick zones can be accomplished with these packers and many highly satisfactory jobs have been so done.

A fracture can extend into water, or into gas caps; therefore, attention must be given to the oil-water or oil-gas contacts with regard to the section of zone to be treated. If the formation in question is known to contain vertical cracks or lines of permeability then this is especially true.

The photograph reproduced as Figure 1 is a typical setup scene on a well in Oklahoma, being prepared for Hydrafrac service. Cementing trucks, kerosine supplies and chemicals are all on hand. Figure 2 is a recording pressure chart taken at the well head during a Hydrafrac job. The cracking of the formation is believed to occur at the pressure peak, the continuing gradual decrease in pressure indicating an extension of the fracture. This well in the Prue sand of Oklahoma had a reported production rate of 54 BOPD and three weeks after treatment 400 BOPD.

After treatment by Hydrafrac methods most established older producing wells have a short period of high production. During the first few days many of these wells exhibit a rather rapid decline rate to a settled production basis showing slow decline. Some sand bodies in either new or old wells have remarkably high production during the early period after treatment. Typical of these is the Red Fork formation in Oklahoma. Of the nearly 200 wells treated in that formation, many have produced by natural flow as high as 300 BOPD, with later settled rates after a few months of from eight to 60 BOPD, which rates hold for longer periods with very little decline.

Among many Oklahoma sands which have shown excellent results are the Gibson, Deese, Prue, Gilcrease, Bartlesville, and Cisco. All of these, while showing the flush production period mentioned, have much flatter decline curves than those of the Red Fork.

Some comparatively soft sands have low permeability. In such cases these sands may not respond well to shooting, yet they frequently make good producers after Hydrafrac treatment. The Lake sand in Eastland County, Texas, is of this type. Over 90 percent of wells in this sand, which have been processed with Hydrafrac treatments, were very successful with potential production rates of 300 to 400 BOPD on the average.

The advent of Hydrafrac services has opened possibilities of new production in areas thought to be completely developed and well down the depletion ladder. The Cushing, Okla., area is a typical case where old wells in the Red Fork have been reworked and many new wells drilled. Many other sections of other oil producing areas offer similar opportunity for revived development.

Spraberry sand wells in Midland and adjoining counties of West Texas have come into widespread interest in recent months primarily because of outstandingly successful production after Hydrafrac treatment. Initial natural production from these wells of about 7,000 foot depth is usually rather low, seldom reporting more than 20 to 40 BOPD by pumping and heading. Over 80 percent of these wells after treatment have had successful increases to as much as 15 barrels per hour by natural flow.

Producing zones which have low bottom hole pressure cannot be expected to show the spectacular production increases found in areas of relatively high pressure. Yet, commercially attractive results have been obtained. The Cypress sand of Illinois and western Kentucky is a good example. Actual results typically show before treatment 0 to 35 BOPD increasing to 5—120 BOPD after treating.

Gas wells in sand and in dense limestone have responded successfully to Hydrafrac treatments. In some instances several hundred percent increases have been achieved.

Depth of wells treated seems to be of little consequence. Success has resulted at depths of less than 800 feet to over 11,000 feet.

The principles of hydraulic fracturing as applied in the basic Hydrafrac process are being expanded by constant research on many variations of the original discovery. The combination use of the hydrocarbon gel fluid, followed by hydrochloric acid is being applied in limestones of low solubility with considerable success. A further variation involving the use of hydrochloric acid made highly viscous by chemical treatment to enable hydraulic fracturing with the acid itself is now under commercial development.

An interesting and important application for the gelled hydrocarbon fluid is its use for sand packing wells to eliminate sand from production. A graded sand of very uniform round grains is carried by the gel out through the casing perforations and deposited against the loose natural sand body. The gel is caused to break down and leave the sand pack in place. The sand thus placed is finally consolidated with a liquid plastic treatment into a solid but permeable mass.

Literally volumes could be written concerning both theory and established fact of Hydrafrac operations. Well histories where these treatments have been applied make a most intriguing story. It is a story of success, the benefits derived from far-sighted research and careful, well planned commercial application, a new and now established means for obtaining more oil and gas at better producing rates and greater ultimate recovery.

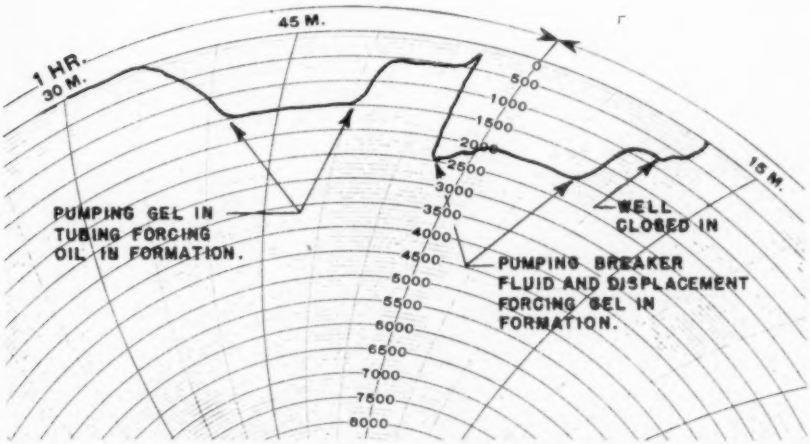


Fig. 2 Typical recording pressure gauge chart from Hydrafrac operations.

Cuttings from rotary drill brought up by air stream and discharged through horizontal pipe connection. Shot hole rig of Seismic Explorations Inc., working near Big Lake, Texas. Photo courtesy Ingersoll-Rand.

Seismic Oil Prospecting With an Air-Cleaned Drill

THE cost of drilling shot holes for seismic exploration in certain areas is being reduced and the operation expedited by the use of compressed air to remove cuttings from the bore. Application has been most general in dry areas where water is scarce, in cold areas where avoidance of freezing is difficult and in cavernous areas where circulation is lost when liquids are depended on to bring cuttings to the surface.

In dry areas the seismic crews may be working 30 or more miles away from the nearest source of water, and are under the necessity of hauling it to the jobs in tank trucks. These trucks often cannot travel back and forth at a rate that will keep the drilling crews busy.

Another annoyance arises from the fact that prospective oil country in a dry region, as West Texas, is generally ranch country. The ranchers view the operations of a fleet of tank trucks with no small dislike. Ranchers have excluded the seismic prospectors from their properties, or have imposed conditions that amount to prohibition. Lost circulation due to extreme cold or caverns has been of even greater importance in delaying shot hole drilling and increasing seismic exploration costs.

For getting around these difficulties, seismic oil prospectors in the regions mentioned have lately become interested in substituting air for water in the drilling of shot holes. Air has the distinct advantage of being at hand everywhere. The use of air for such work has been tried and found good. Expensive truck fleets and their inconveniences can be dispensed with in many if not most such cases. It has been found that if air in sufficient volume and at sufficient pressure is forced down the drill pipe and across the teeth of the rotary rock bits, the drill cuttings are brought to the surface from shot holes 150 feet deep, and in at least one recorded case from a depth of 500 feet.

The inspiration for this use of air in shot hole work came from practice and experience in the quarrying and open mining industries; where it has been used in the drilling of blast holes of from 30 up to 70 feet deep. About five years ago the Joy Manufacturing Co. introduced to the quarry industry an old idea borrowed from the oil industry—the use of a rotary blast hole drill, employing water to remove the cuttings. Since the Joy Co. was also manufacturing air compressors they experimented with air for cleaning the hole. The first such air-using blast hole drill was introduced in early 1949, and since then numerous such drills have been in continuous use in quarrying, strip mining, core drilling for minerals and similar work. The drillers of these air-cleaned blast holes observed what they deem to be remarkable results: longer bit life, faster drilling speeds, and greatly decreased drilling costs. The increased rate of penetration by the air-cleaned drill is ascribed to the fact that when using air instead of water, no eddy currents are set up around the face of the bit to hinder free ejection of the cuttings; a considerable amount of regrinding of the cuttings is thus avoided, leaving the bit more free to attack the virgin rock. Drillers in medium hard and hard limestone quarries in Michigan have reported increased penetration rates of 58 to 66 percent. Associated with this advantage is longer bit life, which is also ascribed to the prompt cleaning of the hole by the injected air; when water is used the cuttings are relatively slow in moving out, and in their presence the bit is subject to more severe wear than it would be when drilling in solid virgin rock.

Among the first to apply compressed air to lift cuttings from shot holes in seismic exploration was Shell Oil Co., operating in the New Braunfels and Edwards Plateau areas of Texas. Experience with Shell rigs in these areas indicated that the operation is consistently successful in medium hard to hard formations. The rigs used by Shell in these experiments are conventional shot hole equipment. The rotary hose is connected to a portable industrial air compressor capable of delivering 315 cubic feet of air per minute with a maximum pressure of 125 psi, except for the absence of water trucks and mud pits, the equipment is the same as that used in the conventional type of drilling. The Hughes Tool Co. and the Shell drillers cooperated in adapting rock bits to this work. Hughes bits currently available for air drilling are of three types: (1) OSC is the most popular for soft rock; (2) OWS for hard rock; and W7R for very hard and very abrasive rock. At first, Hughes provided jets to force a free flow of air across the bearings to overcome heating, but these adaptations were later found to be superfluous.

In the New Braunfels area the formation is predominately medium hard, chalky material; west of San Angelo the layers of limestone are harder. Shell rigs drilling with conventional methods in this area were averaging 1½ holes per day, and required 21 truck loads of water per 100 feet of hole. In the same area, using compressed air to lift the cuttings out of the hole, the same crews have been opening 2½ to 3½ holes per day, which in the latter case amounts to more than a

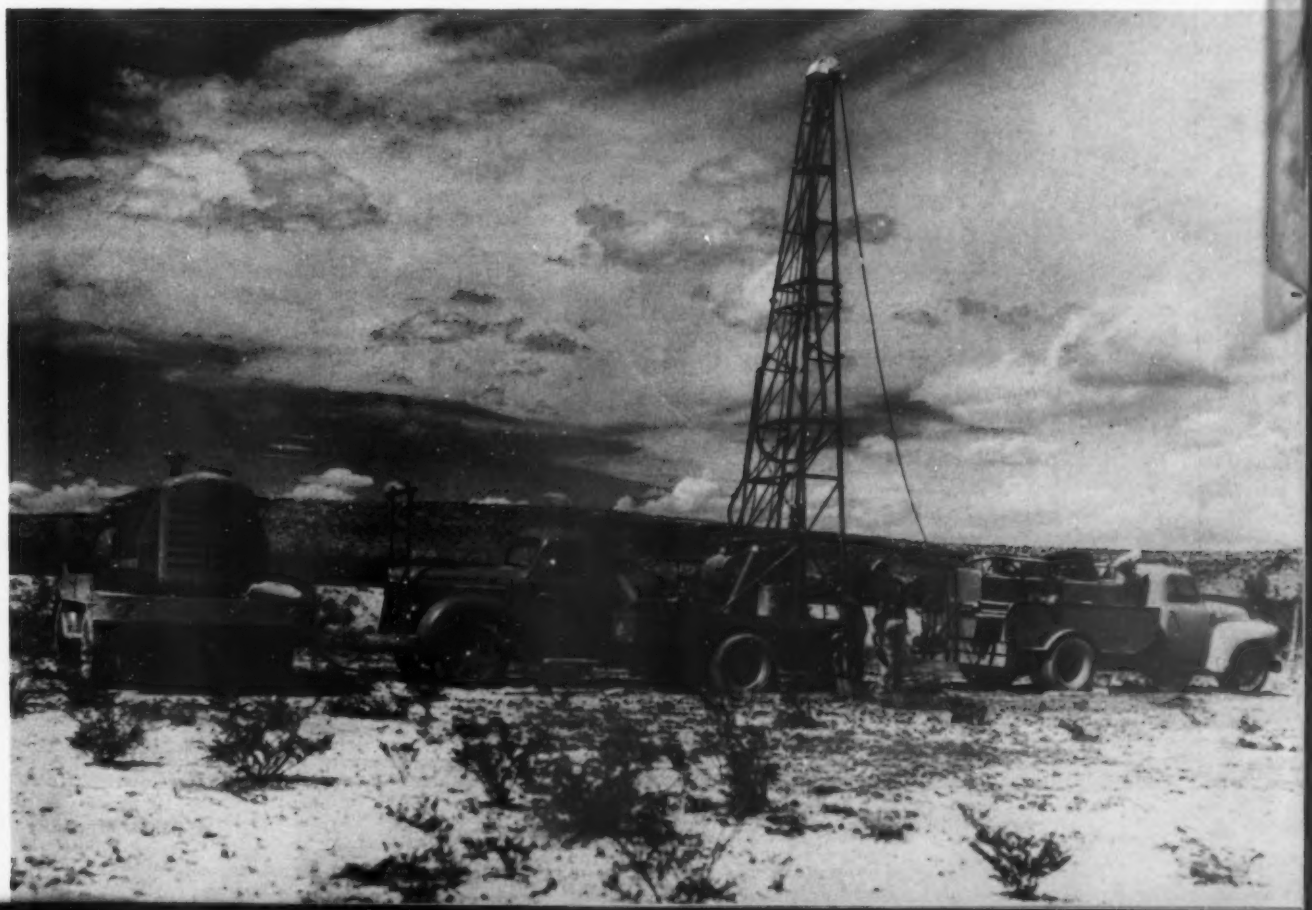
100 percent increase in rate of penetration. One important economic result has been elimination of costly water from the materials bill. Also, the opinion of the quarrymen that rock bits have a relatively longer useful life when compressed air is used as a lifting power has been confirmed for the same reason as given above, namely, that the cuttings are not recirculated when air is used instead of water as the lifting medium. A minor difficulty was encountered when drilling in holes that make a small amount of water. The cuttings then become dampened and cling to the walls of the hole, sometimes making it impossible to pull the drill out of the well. Shell crews solved the problem by washing down and rotating out.

Tests in dry areas having proved that compressed air can be substituted for water as a lifting power, Shell is experimenting with the method as a possible solution of troubles often found in Canadian operations, where winter temperatures go down to forty degrees below zero, and all exposed water is subject to freezing. Experience so far with this type of shot hole drilling in Canada has given promising results.

Already some petroleum engineers, relying on their slide rules, are predicting that it will be possible to open holes 2000 feet deep at a rapid rate. Up to date, the greatest depth reached by Shell crews has been 500 feet. This was in a test where an "air rig" was put in service on the Edwards Plateau near Big Lake, Texas, using $2\frac{3}{8}$-inch drill pipe and a $4\frac{3}{4}$-inch Tricone rock bit having a 1-inch water course with air coming from an Ingersoll-Rand 315-cfm portable compressor. This hole was in limestone down to around 460 feet. At about 375 feet the bit entered a cavernous zone, and instead of coming to the surface the cuttings were blown into the caverns for 10 to 15 minutes, after which they came up as usual. Under similar circumstances a "water rig" would lose circulation, which would be difficult to regain. In this zone the drill lost no time from that cause. After passing the caverns the bit entered a blue clay from 465 to 490 feet when it struck a sandstone formation which produced a large flow of water that rose to the surface, and in conjunction with the air flushed the hole clean; there was no trouble in removing the drill. Besides proving that an air rig can drill down to at least 500 feet, this incident proved two points: lost

Portable compressor at shot hole drilling site. Photo courtesy Failing Supply Co.

Failing shot hole rig of the type which has been adapted for drilling with compressed air. Ingersoll-Rand photo.



circulation, the bane of drillers in numerous cases, is not necessarily a source of trouble in air drilling; and that the presence of much water is not necessarily a handicap to the air rig. As was mentioned above, where there is present only enough moisture to make the cuttings and dust sticky, there may be trouble. Seismic Explorations, Inc., has been active in using air rigs in this plateau region near Big Lake.

In a nearby test another company was using a rotary drill with water, and lost circulation in the caverns. A cable-tool unit was substituted; this unit encountered no difficulties, but it was going down at a rate that would have required five 24-hour days to complete a 500-foot hole, as against the actual two 9-hour days for the air rig.

For a comparison of the air and the water methods of lifting cuttings, the Taylor Exploration Co. alternately drilled holes in the Ballinger, Texas, area. In one month, the air rig put down 68 holes for a total footage of 8240, while the water rig drilled 43 holes for a total footage of 5270. This figures out to a 56-percent faster penetration by the air rig. The formations here were very varied from hard rock to wet clay, sandwiched among conglomerates of gravel and sand cemented by calcium carbonate, layers of dry gravel, and some cavernous zones. The Taylor outfit has been getting comparable results near Graham, Texas; in both areas there have been appreciable reductions of expense.

As another contrast of the two methods a case is cited where a crew of Geotechnical Drilling Co. made two attempts in West Texas to drill a 150-foot hole with a water rig. In 10 hours both holes were down 60 feet, where caverns were encountered, a ton of mud, five loads of water, half a ton of bran, and two rock bits were lost in the effort to go ahead. Then an air rig was put to work between the two abandoned holes and sank a 150-foot hole in three and a half hours. After that, the bit was in such good condition that it was used to drill another hole in the same area.

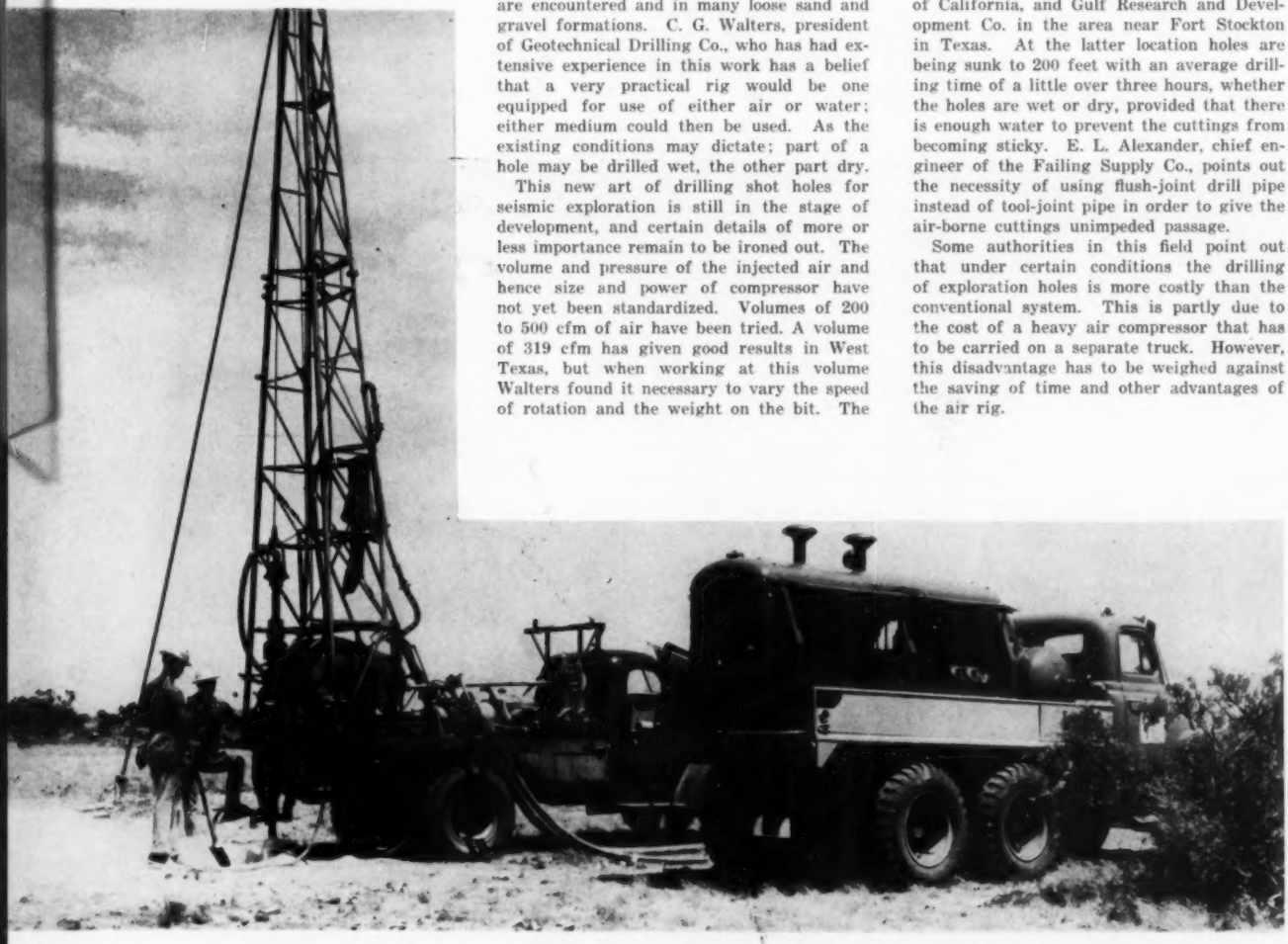
However, although it is apparent that air is superior to water or mud for drilling shot holes under certain conditions it is admitted that substitution of air for water will not obviate all difficulties met with in this work. The air method excels in very cold climates and in dry formations, especially in cavernous rocks where mud circulation is lost. On the other hand, the water method appears to be best where thin water-bearing layers are encountered and in many loose sand and gravel formations. C. G. Walters, president of Geotechnical Drilling Co., who has had extensive experience in this work has a belief that a very practical rig would be one equipped for use of either air or water; either medium could then be used. As the existing conditions may dictate; part of a hole may be drilled wet, the other part dry.

This new art of drilling shot holes for seismic exploration is still in the stage of development, and certain details of more or less importance remain to be ironed out. The volume and pressure of the injected air and hence size and power of compressor have not yet been standardized. Volumes of 200 to 500 cfm of air have been tried. A volume of 319 cfm has given good results in West Texas, but when working at this volume Walters found it necessary to vary the speed of rotation and the weight on the bit. The pressure to be put on the injected air also remains unsettled. In some formations a pressure drop of 20 lbs. across the bit appears to be sufficient. In other formations a pressure drop of 100 lbs. seems to be necessary. In air drilling it appears feasible to use the same bits as in water drilling, but experience in various areas has shown that much has yet to be learned about the proper type of bit and the proper arrangement of air outlets in the bits, and also the size of bits. After using openings of ¼ to 1¼-inches, Walters admits that he is still undecided as to what is the right size of opening for any condition.

Another annoying problem relates to the disposal of cuttings, and especially the dust that comes out of the air drilled hole. The air rigs, now in use, have a sleeve over the top of the hole that deflects the cuttings and dust to one side. Aside from the dust that chokes the drillers, the ejected material tends to choke the surface outlet. No one has come up with a device that will suppress this annoyance. Also, the Kelly type of rotating stem is ruled out as a promoter of choking the hole; the air blast hose is preferably connected directly to the swivel. This arrangement is featured in the "Holemaster" drill No. 1500 of the Geo E. Failing Supply Co., which is being used by the Sun Oil Co., the Canadian Superior Oil Co. of California, and Gulf Research and Development Co. in the area near Fort Stockton in Texas. At the latter location holes are being sunk to 200 feet with an average drilling time of a little over three hours, whether the holes are wet or dry, provided that there is enough water to prevent the cuttings from becoming sticky. E. L. Alexander, chief engineer of the Failing Supply Co., points out the necessity of using flush-joint drill pipe instead of tool-joint pipe in order to give the air-borne cuttings unimpeded passage.

Some authorities in this field point out that under certain conditions the drilling of exploration holes is more costly than the conventional system. This is partly due to the cost of a heavy air compressor that has to be carried on a separate truck. However, this disadvantage has to be weighed against the saving of time and other advantages of the air rig.

Seismic Explorations, Inc., rig working in the Edwards Plateau region in West Texas.



Tax Policy and Petroleum Supply

Hines H. Baker

By Hines H. Baker
President Humble Oil and Refining Company

The following article is condensed from a paper presented by Mr. Baker before a session of the Production Division of the American Petroleum Institute at the annual meeting of the Institute in November 1950. At a time when the national interest demands an intensification of the search for oil it is of vital importance to maintain a tax policy that will not discourage investors from undertaking the high risks involved in exploration. While reasons of space prevent the reproduction of the paper in its entirety it deserves careful study by members of the oil industry since questions of taxation are certain to receive the attention of the Congress at its present session.—Editor

SINCE the first income tax law was passed in 1913, Congress has recognized that such laws must take into account the depletion of national resources incident to production. Depletion is comparable with depreciation on other capital assets. Both depreciation and depletion must be recognized in income tax laws in order to avoid the fundamental mistake of taxing capital as though it were income. The Sixteenth Amendment to the Constitution authorized tax on income only, and not on capital. Whenever income taxes are imposed, it becomes necessary to define and distinguish between capital and income so that the receipts of a taxpayer which represent the return of capital are not subjected to taxation as though they were current income. This distinction is essential to protect capital assets, including basic natural resources, so that capital may be replaced and additional capital attracted into the productive operations that create income.

The problem of measuring capital is relatively simple in the average business. In most activities of normal risk the capital is about the same as the investment in productive facilities. If a firm invests $1,000,000 in a plant which will last twenty years, its depreciation is at a rate of $50,000 a year. Such depreciation is deducted from gross income each year in arriving at net taxable income. That principle applies with equal force to the refining, transportation, and marketing activities of the petroleum industry. In the case of oil and gas exploration and production, however, as for all other natural resources involving considerable hazard, investment in a property is not an adequate measure of capital value created by the developer of new resources. To encourage continued exploration, depletion provisions must take into account the capital value of the resources themselves.

What is the capital that should be allowed for the depletion of natural resources discovered on a property as a result of hazardous exploration? It is not merely the investment in a particular productive property, for under such a narrow interpretation the capital risked and lost in non-productive ventures would be entirely overlooked. It takes the exploration of many leases to locate one structure with sufficient promise to warrant an exploratory test, and less than one in five such tests discovers a new field. That means that the capital risked in the search for oil is much more than five times the amount spent in locating the discoveries. In such circumstances, it would be unfair by any reasonable standard to limit the capital returnable by depletion to the amount spent on productive properties. Even if an operator has sufficient other income against which he can deduct his non-successful expenditures (which might not be the case for one seeking to get started in the business), that only reduces his taxes without actually returning the capital lost or providing an opportunity to earn a profit on it. The hope and realization of large reward for unusual success is indispensable to induce enough operators to take the risks involved in the search for new oil. Naturally, the reward should be in proportion to success in finding oil. The value of a new discovery is governed by the volume of oil discovered, and not by the amount of money spent in locating it. As the property is depleted of resources, that value declines. Depletion provisions must reasonably consider that value. It is proper and reasonable, therefore, to measure depletion by capital value in the case of a resource, such as oil, which requires a hazardous search for its discovery.

As a property is produced it experiences a decline in value for two reasons: (a) the depletion of the oil and gas, and (b) the depreciation of the wells and equipment which make possible the production. Provision must be made for the consideration of both depletion and depreciation in the income tax laws to deal fairly with petroleum producers, and all producers of natural resources in general, as compared with other business activities. Congress has studied this question carefully since the introduction of income tax laws and very early in the history of those laws worked out a fair and sound system which has been in effect for more than a quarter of a century. In that period of time it has worked simply and equitably. By protecting the capital value developed by successful producers, as intended by Congress, it has attracted into the search for and development of oil the billions of dollars which have been and will continue to be required to supply this country with increasing quantities of oil and gas. Domestic production of petroleum liquids in 1950 was about two and a half times as much as in 1926, and the marketed production of natural gas was about five times as much as in 1926. These increased supplies of oil and gas have accounted for all of the additional energy consumption in the United States since 1926. They have added enormously to the productive capacity of the United States in agriculture, in industry, in transportation, and in other basic economic activities.

The principle of percentage depletion now seems accepted beyond question, but sometimes the question is raised whether the rate of 27.5 per cent is correct. The best economic evidence of the reasonableness of this rate is its close reflection of the capital value of oil in the ground. At the present time on an average price of crude oil of $2.55 a barrel the maximum percentage depletion is 70 cents, and the average depletion is about 63 cents because of the limitation to 50 per cent of net income. This depletion allowance agrees very closely with the discovery value of oil in the

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NET INCOME AND RATE OF RETURN OF LEADING CORPORATIONS

	Manufacturing (NCB)			Trade (NCB)			Petroleum Products (NCB)		
	Net Income (Mil. $)	Net Worth (Mil. $)	Rate of Return-%	Net Income (Mil. $)	Net Worth (Mil. $)	Rate of Return-%	Net Income (Mil. $)	Net Worth (Mil. $)	Rate of Return-%
1938..	1,067.5	23,209.8	4.6	154.5	1,788.9	8.6	190.0	4,119.7	4.6
1939..	2,095.5	25,125.2	8.3	211.7	1,896.3	11.2	230.4	4,649.3	5.0
1940..	2,628.1	25,597.8	10.3	205.0	1,945.6	10.5	252.0	4,689.9	5.4
1941..	2,925.6	23,807.9	12.3	233.5	2,122.1	11.0	306.5	3,583.6	8.6
1942..	2,521.5	24,905.9	10.1	216.2	2,177.4	9.9	259.0	3,693.2	7.0
1943..	2,729.5	28,474.1	9.6	235.3	2,334.8	10.1	498.9	6,196.8	8.1
1944..	2,889.8	29,556.9	9.8	244.6	2,408.3	10.2	624.9	6,443.0	9.7
1945..	2,997.9	32,167.8	9.3	275.2	2,534.0	10.9	596.7	6,778.7	8.8
1946..	4,111.9	34,005.4	12.1	624.5	2,850.2	21.9	769.6	7,174.3	10.7
1947..	6,317.0	37,062.3	17.0	615.8	3,368.4	18.3	1,215.9	7,712.5	15.8
1948..	8,172.4	44,959.8	18.2	707.7	3,880.2	18.2	1,930.1	9,160.6	21.1
1949..	6,998.5	50,656.0	13.8	577.0	4,358.2	13.2	1,420.7	10,761.4	13.2
Avg...	3,787.9	31,627.4	12.0	358.4	2,633.7	13.6	691.2	6,246.9	11.1

	Oil and Gas Producing (NCB)			Combined Petroleum Products and Oil and Gas Producing (NCB)			30 Oil Companies (CNB)		
	Net Income (Mil. $)	Net Worth (Mil. $)	Rate of Return-%	Net Income (Mil. $)	Net Worth (Mil. $)	Rate of Return-%	Net Income (Mil. $)	Invested Capital (Mil. $)	Rate of Return-%
1938..	19.9	317.6	6.3	209.9	4,437.3	4.7	300	6,203	5.1
1939..	15.8	298.0	5.3	246.2	4,947.3	5.0	321	6,290	5.4
1940..	12.7	297.8	4.3	264.7	4,987.7	5.3	377	6,234	6.3
1941..	22.1	265.6	8.3	328.6	3,849.2	8.5	530	6,352	8.8
1942..	24.6	272.7	9.0	283.6	3,965.9	7.1	403	6,494	6.6
1943..	27.6	233.5	11.8	526.6	6,430.3	8.2	510	6,751	8.0
1944..	30.9	247.9	12.5	655.8	6,690.9	9.8	640	7,106	9.6
1945..	31.0	273.7	11.3	627.7	7,052.4	8.9	602	7,485	8.6
1946..	35.3	292.9	12.1	804.9	9,467.2	10.8	763	8,002	10.3
1947..	70.0	352.0	19.9	1,285.9	8,064.5	15.9	1,219	9,054	14.9
1948..	134.7	387.3	34.8	2,064.8	9,547.9	21.6	1,877	10,631	19.8
1949..	107.9	496.2	21.7	1,528.6	11,257.6	13.6	1,368	11,465	12.8
Avg...	44.4	311.3	14.3	735.6	6,558.2	11.2	743	7,672	9.7

NCB—National City Bank CNB—Chase National Bank

Some Requirements for Future Progress in Geophysical Prospecting

By H. M. THRALLS

THE value of geophysics to the oil industry cannot be easily calculated, but the profession certainly has been a prominent factor in maintaining the nation's reserves. The greatest service of the profession has been its contribution towards finding structural (deformational) anomalies that act as oil reservoirs. Undiscovered features of this type are now increasingly difficult to find since each discovery decreases still further the number of structures yet to be found. The stratigraphic trap type field still eludes the majority of geophysicists. Good geophysical methods, combined with excellent geology, has led to the discovery of some stratigraphic type traps and will lead to still more. The average geophysicist, however, is dissatisfied with his present approach to the problem of delineating a stratigraphic trap. There is no question about the ultimate ability of the geophysical industry to find stratigraphic traps, but two major changes in attitude are necessary for a rapid development of satisfactory techniques. First, management needs to acquire a deeper understanding of the geophysical industry and its problems. Second, the geophysicist must become an expert geologist or obtain the consulting services of an expert geologist when making an interpretation. These two major needs are not necessarily related but both must be fulfilled before any rapid strides are made in the geological interpretation of geophysical data.

The rate of improvement in geophysical prospecting has been and will be controlled primarily by the executive and management groups in the oil industry. The policies which these groups impose upon the geologist and geophysicist are the controlling factors of progress. It may be difficult for management to appreciate this statement but it will be still more difficult to convince the average geophysicist that the statement is untrue.

Geophysical contracting companies and company owned geophysical departments all offer a product, the product being geophysical data transcribed to present some significant geological conclusion. When a contracting company offers its service to management it is usually offered as a complete unit at a specified cost (plus extras) on the day, week or month basis. From management viewpoint the unit offered by all companies may look the same. These units appear to be composed of similar equipment and a similar number of technicians. It is just as difficult to analyze the variation in ability of these crews as it is to decide whether the well dressed stranger standing on the corner is a lawyer, doctor, banker, or merchant. The tendency for the executive, since he is interested in efficiency and economy, is to choose the one offering the lowest rate. He has done this with drilling contractors and other types of contractors and achieved good results. Why is this any different? The difference, in the case of the geophysical contractor, lies in management's inability to put specifications on the product he buys. None of the contractors will guarantee to find an oil field, or that their conclusions will be infallible. The value of the product the client receives is dependent not only on the abilities of the group of technicians he hires, but on the care which they use in applying these abilities.

Contract seismograph companies offer services varying approximately ten per cent in total cost of operation, from the lowest to the highest bidder. Hiring the most expensive crew doesn't necessarily insure the best job. However, a contract company which consistently asks and receives a higher fee for its services than its competitor, must have gained a reputation of producing a reliable product. In some instances at least, the difference between the low cost crew and the more expensive crew is the amount spent by one company for "insurance"; that is, it is furnishing additional brain-power and brain-power hours to insure its client against arithmetical errors, errors in observation, and errors in interpretation which could lead to the drilling of an expensive dry hole, or to a much more disastrous missing of an oil field. A single geophysical company cannot give the client a variable choice in the matter of "insurance," for all contracting companies must decide when they build their company whether they are going to give the client no insurance, a small amount of insurance, or adequate protection. This protection is determined by the adequacy or inadequacy of a complete interpretative instrumental, and civil engineering supervisory staff. It is quite probable that the higher priced contractor could meet the low bid of his competitor if he wanted to take a chance on giving a hit or miss service. The contractor asking the higher price is usually the one who plans to be in the business for years to come.

H. M. Thralls, vice president of Seismograph Service Corp., author of this article, has had more than 17 years experience in seismograph work. He joined Seismograph Service in 1936, was made chief geophysicist in 1945 and vice president in 1949.

There are two things that keep geophysical companies in business: (1) a month-to-month acceptable cost of unit coverage; and (2) a good quality interpretation. The thing that keeps them in business from month-to-month is item No. 1. Regardless of the quality of their work, efficient executives won't allow them to continue unless the unit cost falls within acceptable commercial limits. However, the thing that keeps a company in business down the years is the quality of work it performs. Because of the usual long period between the inception of a prospect and the completion of a well or dry test, the interpreter may not be checked on quality for two years or more. By the time the test is completed the operator has completely forgotten the cost of the geophysical exploration. The only thing that impresses him at the time of completion of the test well is the quality of the interpretation. If the geophysical contractor expects to stay in business for years to come, he must "insure" the quality of the product for his client, and good insurance of this type costs the contractor from ten to twenty per cent of his service charge.

The scientific oil finder, whether he be a geophysicist or geologist, seldom is furnished with enough brain-power or brain-power hours to do the type job expected of him. If management would make a break down of exploration costs to a total for material and labor and a total for brain-power, it would find some surprising statistics. It would find, if the analysis is proper, that the proportion actually spent for brain-power cannot be placed at much more than ten per cent of total costs. In other words, if the interpretative effort were doubled, the total exploration costs would be increased by only ten per cent.

In the majority of instances the geophysical interpreter is unsatisfied with his interpretation, and without the cooperation of management there is little chance of his achieving an interpretation which he feels represents his best efforts. Why? The present standards of geophysical work were set in the early days when undiscovered structures were still plentiful. Very simple computational methods and simple field procedures were adequate to find the major features. As time has passed, most of these major structures have been found and the interpreter has had to follow more complicated procedures to unearth the second, third, and fourth class structural features. The ac-

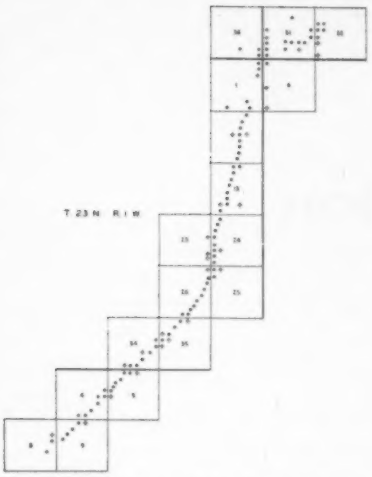


Fig. 1. Present producing area of South Ceres field, Noble County, Oklahoma.

tual work and study done in some seismograph field crew offices, for instance, is approximately four times what it was in 1935, but the accepted commercial staff is either the same size (on the crew of some of the low bid contractors) or increased by fifty per cent over that of 1935 (normal office force of the high bid contractor). Even the increase of fifty per cent in office staff is misleading, for the New Deal and Fair Deal governments have succeeded in complicating business operations to a point where the fifty per cent increase in office staff is just about great enough to take care of added red tape. The net result of the increase in work has resulted in a forced routine, with little time for analysis. The interpreter is like the fictional man on the automobile assembly line; if he drops his wrench he is five cars behind. This state of affairs kills most of the progress that could be made in developing new interpretative approaches. Brain-power is so overworked just following a developed technique that there is no time or energy for thought.

It is possible that management, in some instances, may take the position that field interpretations should be routine; that field crews should follow routines which have been established by research. Although the geophysicist can produce a thousand arguments against that statement, it is easier to quote statistics. One of the major seismograph companies (a high bid company) puts about four percent of its gross income into research. It is probable that some of the oil companies put a considerable higher dollar volume per field unit into research than this contracting company, but a great many of the contractors (usually the low bid contractors) do no research at all. Actually a very high percentage of the money allocated to research is spent to build better instruments and better equipment so that a lower cost per unit of field work can be achieved. In other words it is spent primarily to enable material and labor to further overburden an already inadequate brain-power. It is difficult to guess what part of the exploration dollar goes into an attempt to better interpretation methods but it is safe to say that less than one cent in each exploration dollar is so applied.

The geophysicists and geologists hunting the nation's oil are competent. One of their major needs is the cooperation of a sympathetic and enlightened management. The greatest boon to the industry would be a ten percent increase in exploration budgets earmarked specifically for the purpose of adding brain-power hours. Since brain-power is the cheapest of commodities in which an oil company deals, the added appropriation would not demand any great sacrifice. Probably one less deep wildcat test per year on the part of each oil company would pay the bill.

The geophysical industry has grown by fairly rapid strides in thirty years from virtual non-existence to a full-fledged industry. Methods using different physical properties have been added one by one until the industry covers the measurement of all major physical properties. It is the hope of those desirous of rapidly increasing known oil reserves that some new and different method will be discovered that will make petroleum easier to find. Most men closely associated with the geophysical industry consider this a false hope in that they know of no new physical property of the earth they can measure. They are looking primarily to the improvement of known methods or combinations of methods for the discovery of future reserves.

The term geophysics, in the minds of those who call themselves geophysicists, has taken on a new meaning within the last decade. During the "twenties" the physicist invaded the field of oil exploration. Some geologists resented the encroachment of the physicist into his domain of choosing locations for wildcat wells. The physicist was firmly convinced that he could get along without the geologist; that, by measuring some physical properties of the earth, he could pick favorable structural locations for new drill tests without ever consulting a geologist. As time progressed the physicist became a geophysicist and the geologist and geophysicist each gained a better knowledge of the other's problems and a greater respect for the other's abilities. Today the time appears to be not far away when all exploration geologists must become geophysicists and geophysicists must become geologists if the industry is to maintain adequate petroleum reserves. The thinking geophysicist has learned that his interpretations must be based on an intimate knowledge of local and regional geology if he is to draw the proper conclusions. He has learned to look on the title "Geophysicist" as one which requires a combined knowledge of geology and the physics of the earth.

In the case of the seismograph, the standard objective in a survey is to find an area

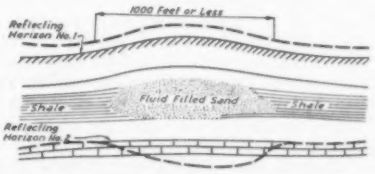


Fig. 2. Simplified geologic cross section of South Ceres field.

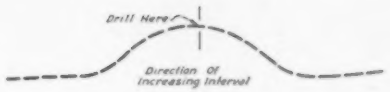


Fig. 3. Generalized seismic time interval across Ceres field.

of minimum time observations on a map of a particular horizon. These times, translated into depth in feet by some sort of velocity function, usually predict a minimum depth at the points of minimum time. If the subsurface structure is of sufficient relief, (100 feet or more) and if the interpretation is made by accepted standards, the chances are good that a subsurface structure has been discovered. However, if the subsurface anomaly shows fifty feet or less of critical closure, and if the details of geology in the area are unknown, the odds may be no better than even that the feature will actually represent structure. If the geologic section above the reflecting horizon maintains a constant average rate of energy transmission, or if the changes follow a predictable pattern, the map made from a careful interpretation of seismic data may be extremely accurate. However, the seismologist has no way of determining except by experience in a certain area what variables are likely to exist between control points. If the variables do exist and are not recognized and accounted for, the data of the survey will contain an appreciable error. Time differentials, interpreted as a structural feature of fifty feet or less may be the result of rapid changes in lithology, and a detailed knowledge of the geology of the area is necessary before a proper analysis of the time data can be made.

An example of an unusual interpretation of a seismic time anomaly is the technique devised by Seismograph Service Corporation to delineate a shoestring sand bar. The basic idea behind the method was conceived while listening to a geologic paper given by E. P. Neal, geologist for Tide-Water Associated Oil Company, at a luncheon meeting of the Tulsa Geological Society. The paper described in detail the geology of the South Ceres field, Noble County, Oklahoma. The present outline of the field is shown by the production map in Figure 1. The northern extremity of the field on the date Mr. Neal's paper was given was the north line of Section 24, Township 23 North, Range 1 West. Figure 2 shows a simplified geologic cross section similar to that shown by Mr. Neal. The Pink Lime lies draped over a Red Fork and Burbank sand section. The draping may or may not be the result of differential compaction but nevertheless the draping is present.

Born and Owen, Amerada Petroleum Corporation, in their article describing measured velocities of an Amherst Sandstone bar*, give experimental data which show a decreased velocity with increased fluid content of an Amherst Sandstone bar. These measurements although laboratory conditions are not necessarily correlatable with conditions in the subsurface, suggest that seismic times below a fluid filled sand lens may show a false syncline equivalent to the delay time caused by the presence of the bar. Seismograph Service

* AAPG Bulletin—January 1935.

(*Please turn to page 94*)

Low Temperature Separation For Gas-Distillate Wells

By George F. Russell*

WITH distillate values approaching three dollars per barrel and gas marketing conditions good and improving, gas-distillate well owners are taking another look at the reasoning behind the universally accepted heater-separator gas production practice. An added impetus toward more efficient extraction methods for the recovery of liquid hydrocarbons from natural gas has been brought about by a stable natural gas economy resulting from the discovery of enormous gas reserves and great gas transmission systems.

Producers are finding that thousands of net dollars per year can be added to the present gas well income by efficient utilization of the old refrigerating effect of throttled gas to extract a larger percentage of the gasoline content of the separator gas, and to produce a low water content gas for delivery into gas transmission systems. Through the mutual cooperation of gas producers and equipment manufacturers, better gas production techniques have made possible potential increases in distillate recoveries ranging from 10 to 30 percent depending upon compositions, pressures and past production practices. Added benefits accrue simultaneously from the reduction of water vapor content of the natural gas at the well-head. This general increase in overall efficiency has been achieved with a surprisingly low cost of application.

The importance of operating oil and gas separators at minimum temperatures for best liquid recoveries has been recognized for years by the producers of oil and natural gas. Progress has been slow in the development of the more efficient production methods such as what is now known as "low temperature" separation, extraction and dehydration for gas-distillate wells. Quantitative evaluations of determinations of the benefits to be derived from low temperature separation have been difficult to make due to production variables such as gas-oil rations, temperatures, pressures, and natural gas demands.

As early as 1935 production men demonstrated the advantage of withdrawing the excess liquid water from the gas stream before reducing the gas well pressure, thus lessening if not eliminating the usual tendency for a high pressured gas well to freeze. However, the high cost of high pressure separators, the relatively low distillate dollar benefits, the uncertainty of theoretical calculations, and a general prejudice against an externally iced-up system all combined to oppose adoption of the now revived "low temperature" operations.

With modern advancements in well-drilling technology came deeper wells and higher pressured gas producing operations. Production men observed at an early date that some wells produced a high gravity liquid, which if properly "weathered," could be used as a low grade motor fuel. This liquid because of its physical similarity to the refinery product "pressure distillate," was dubbed "distillate." Other names such as "condensate" have also been used to designate this product of retrograde condensation. It was indeed a mysterious liquid which condensed when the pressure was reduced; it was water-white and showed no signs of crude oil contamination.

At times when this distillate was difficult to market because of lack of transportation, it was trapped, dumped and wasted. In other cases the liquid was collected and the natural gas exhausted to the atmosphere by the multi-millions of cubic feet per day. State conservation regulations ultimately put a stop to this extravagant practice. Until recently, the selling price of distillate did not warrant more than a passing consideration of the potential extra distillate which was known to be present in the separator vapors.

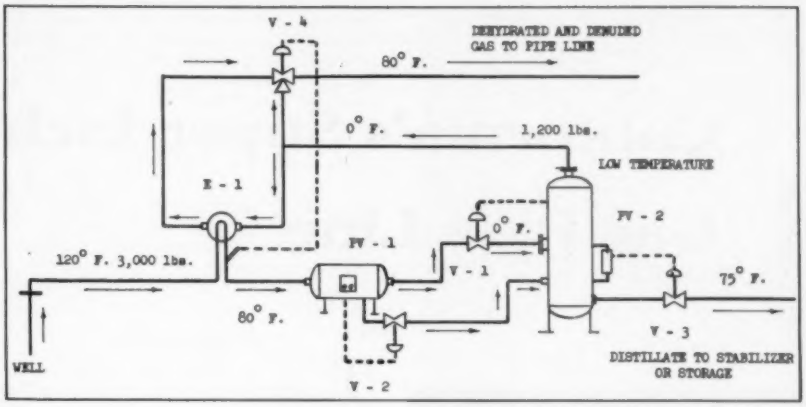
Where all conditions of marketing and conservation permitted, the steady flowing of these high pressured gas-distillate wells was not achieved without some inherent difficulty. Even in the warmest weather a large percentage of the wells and separators would freeze with gas hydrates (a porous, snow-like chemical combination of water and hydrocarbons). The free water produced with the gas formed the solid gas hydrates in the flow-control chokes, the lines to and from the separators as well as inside the separators themselves. In locations where the gas was delivered into gas pipe lines, the erratic flow was very troublesome to the gas pipe line transmission companies, for in the coldest weather the gas service was likely to fail.

One of the first obvious methods to overcome this freeze-up condition was to drain the water before it had time to freeze. The general reaction to the use of this method has been mentioned above.

Another early method used to combat this tendency to freeze-up due to auto-refrigeration was to inject an alcohol antifreeze into the system. In order to inhibit all the connate, interstatial and condensed water which was produced along with the gas and distillate, excessive amounts of alcohol were re-

George F. Russell has been president of Russell Engineering Corp. since the firm was organized in July 1950. He has been a specialist in high pressure natural gas processes since his university days when he received the American Gas Association research fellowship in the graduate school of the University of Oklahoma. He taught at Oklahoma and later was associate professor of natural gas and petroleum engineering at Baton Rouge, La. Prior to entering consulting engineering work in 1948 he had been associated with Phillips Petroleum Co., Esso Standard Oil Co., Hudson Engineering Corp. and Consolidated Western Steel Corp.

*Consulting Chemical and Petroleum Engineer, Houston, Texas.



Typical low temperature separator hook-up.

quired. Also, it was difficult to anticipate the antifreeze requirements for each well. Since there was no practical means to recover the alcohol for reuse such as we now have for the glycols, the unbridled use of antifreeze was generally conceded to be an expensive solution to the problem.

The application of heat was also a solution to the freeze-up problem. Various types of well-head heaters were developed and installed to raise the temperature of the well fluid to a degree such that, upon reducing the pressure for pipe line delivery, the auto-refrigeration effect would not lower the gas temperature to the critical region of freezing. This heater method of freeze-up control was so successful that it became the accepted standard gas production practice by the oil and gas industry. The problem of well-head freeze-ups was conquered.

About 98 years ago, 1852, J. P. Joule and W. Thomson (Lord Kelvin) first demonstrated the cooling effect of throttling a gas from high to low pressure. This change in temperature with changes in pressure for all gases has since been known as the Joule-Thomson effect. At ordinary temperatures the only gases which do not exhibit a lowering of temperature upon lowering the pressure are helium and hydrogen. All present day plants for the commercial extraction of oxygen from the atmosphere are special applications of the Joule-Thomson effect.

The U.S. Bureau of Mines has been separating helium from natural gas by selectively extracting the hydrocarbons at low temperature and high pressure, also using the Joule-Thomson effect and countercurrent heat exchange. When the system fills with ice or hydrates, de-icing is accomplished by warming and purging.

Hence, the present trend in low temperature separation cannot be attributed to a completely new discovery, though parts of the general principle were not previously known to some people. The U.S. Patent Office has been issuing patents on low temperature means for improving distillate, gasoline and crude oil recoveries since 1907. No value was placed by the early patents on the dehydration or dehumidification benefits which resulted from the cooling of the gas.

Unlike the previously mentioned method for liquefaction of gaseous hydrocarbons, the well-head low temperature extraction units require no expensive compressors for compressing the gas to high pressure before expansion. Nature has supplied this compression work free of charge as a natural resource. There are several possible ways to utilize the Joule-Thomson effect of the necessary pressure reduction for improved distillate recovery and controlled dehumidification; each set of gas well flowing conditions dictates the optimum method to be employed. In most cases it has been found desirable to cause the cold expanded gas to pre-cool the high pressure well-head gas as shown in Figure 1. The amount of distillate recovered in the stock tanks can be shown to be an inverse function of the total heat content or enthalpy of the high pressure well head gas immediately preceding the reduction in pressure.

Normally, as shown in the accompanying diagram, the well-head gas is cooled at cooler (E-1) to a temperature above the hydrate freezing point (if no antifreeze is employed), the condensed water or hydrocarbons are withdrawn from the high pressure separator (PV-1) and discharged through a separate line into the cold separator (PV-2). The liquids are thus not exposed to the frigid temperatures which are produced by the expanding gas.

The high pressure gas is then throttled through flow control choke (V-1) from essentially 3,000 pounds per square inch to the lower pressure of approximately 1,200 pounds per square inch gauge. The Joule-Thomson effect is a drop in temperature across the choke from 80°F. to approximately 0°F. in the pipe line gas separator. The liquids and entrained gas hydrates are scrubbed out of the gas, fall to the bottom of the separator and are withdrawn. The cold gas then passes through the cooler (E-1) where it exchanges heat with the warm high pressure gas, and finally discharges into the pipe line system. The amount of cooling required at E-1, the exchanger, is dependent upon the temperature of the well fluid together with the pressure, quantity and composition. Because of the relatively wide spread in the variables of a low temperature installation, considerable savings in equipment sizes and materials can be achieved by specifically designing each low temperature extraction unit for the specific condition under which it is to operate. A rigorous thermodynamic energy balance must be made if the precise increase in recovery and minimum temperature of operation are required prior to installation. Detailed calculations may not always be necessary where similar units have already been in operation.

Using low temperature separation followed by stage separation, 20 to 40 percent of the natural gasoline content of a conventional separator tail gas to pipe line can be extracted at the lease, depending upon the particular methods, operating conditions and equipment employed. This can amount to approximately two to four barrels per million standard cubic feet increased production for an average distillate well.

For the greatest extraction efficiency, midget absorbers and stabilizers should be used, recovering 99 percent of the gasoline content of the gas. This amounts to possibly eight to ten barrels of distillate per million standard cubic feet of gas to be added to previous conventional heater-separator recovery. High propane recovery can be accomplished at a cost which is considerably less than that of processing in a conventional absorption or hypersorption plant. This is due, of course, to the absence of steam boilers, electric generators, cooling towers, water requirements and other auxiliary equipment. Further economies are affected by shop fabrication and piping of equipment, thus eliminating the necessity and cost of field construction. The result is an earlier pay-out on the capital investment.

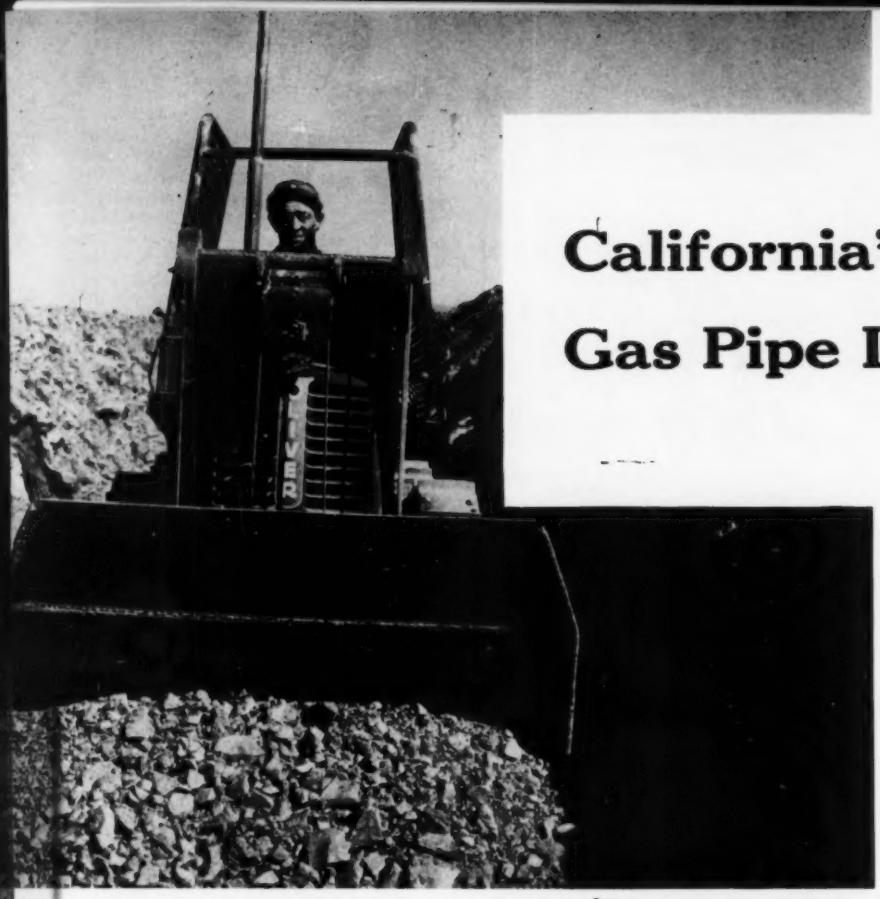
As a generalization, one might say that for the leaner, or lower gasoline content gases, a simple low temperature separator with possibly three-stage separation gives the greatest percentage return on the investment. Such a system can improve the net income from $2,000 to $5,000 per year for a two million cubic feet per day high pressure gas distillate well. It should be understood that the figures quoted here are contingent upon a number of conditions which change with each well and location.

For higher propane and richer gasoline content separator gases, a midget oil absorber extraction unit can improve the net income by as much as $30,000 per year for a two million cubic feet per day capacity well, and assuming current selling prices of products.

The residue gas from either of the above systems will have a dew point for water at a temperature which conforms to the specifications of most major gas pipe line purchasers.

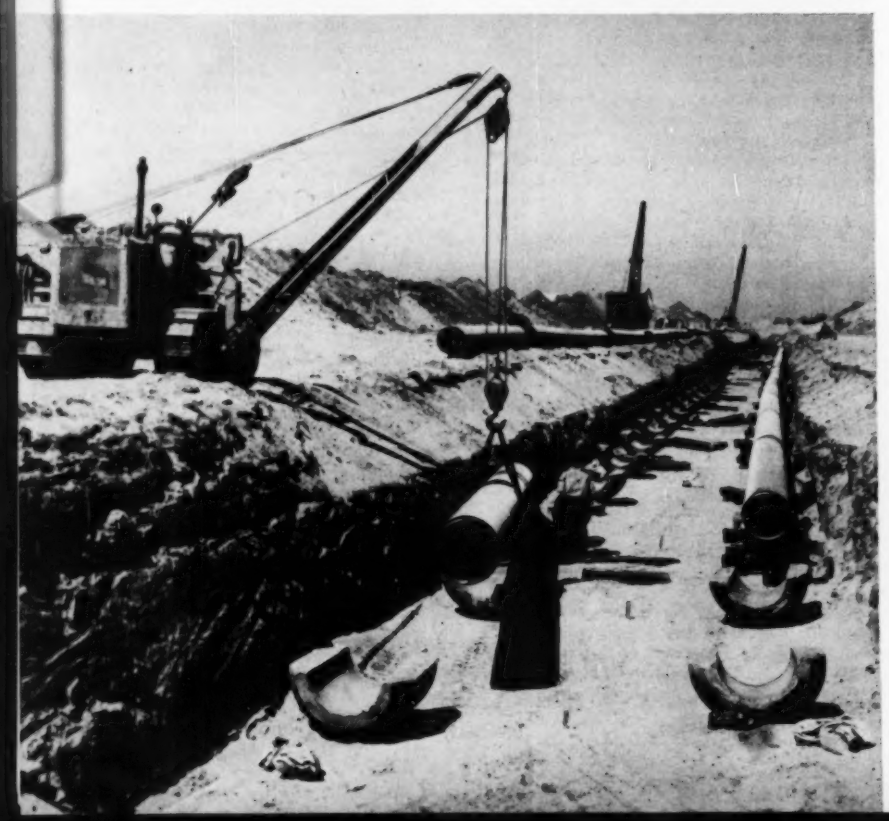
In conclusion, to use the words of a natural gas engineer for a major oil company, "It looks like low temperature extraction is here to stay." Statistically, it might be said that if all the gas-distillate well pressure of proven reserves were fully and efficiently exploited, an additional $10,000,000 per year could be realized in the net earnings for the producers of natural gas. Or further, based upon a recent estimate by Lyon F. Terry of the Chase National Bank, the unproven gas reserves in the tidelands of the Gulf of Mexico alone should yield an additional $250,000,000 through efficient low temperature improvements.

California's Super Inch Gas Pipe Line



The "Doodlebug" a tractor with a 42-inch blade used to level and smooth the trench floor. All photographs with this article are by the author, Richard Finnie.

The crossing of the Mojave River near Barstow was done during the dry season. Two 26" Somastic-coated lines were anchored with concrete weights. In this picture only the bottom halves are in place.



By Richard Finnie

TO MEET the growing needs of more than a million customers in 46 counties of central and northern California the Pacific Gas and Electric Company has completed the greatest long distance gas pipe line ever laid. The line, 502 miles in length from Needles on the California - Arizona border to Milpitas at the southern end of San Francisco Bay, is of 34-inch diameter, can deliver four hundred million cubic feet of gas daily and is capable of increase later on as needed.

In reality the California line is an extension of a system reaching 1,600 miles across the southern United States and the fuel which it delivers on the Pacific Coast is brought all the way from Texas to slow the depletion of California's known gas reserves and to meet the growing requirements of an area in which the population has almost doubled in the past decade. Among the growing number of large diameter lines built during and since the late war it is entitled to be called the super inch, though how long it will retain that position remains to be seen.

Not only in the matter of size is this California line superlative but its construction brought into play probably the most advanced methods and the most efficient equipment ever employed on a project of its kind. In this respect its builders had the advantage of experience in construction practice and in overcoming physical obstacles gained in the laying of other lines of successively larger dimensions in various parts of the world.

Contract for building the line was placed at the beginning of 1949 with the Bechtel Cor-

Photographed along the right-of-way during construction, left to right, S. D. Bechtel, Jr., assistant superintendent; William Hanna, superintendent; H. V. Hindmarsh, vice president, Bechtel Corp., S. D. Bechtel, president and board chairman, Bechtel Corp.

poration of San Francisco and its associates, H. C. Price Co., R. A. Conyes and Morrison-Knudsen, all with long experience in this type of work. Immediately following the placing of the contract, survey of the line and preparations for actual construction began. The route led over mountains, across desert and through populous valleys, presenting almost every kind of natural problem that the pipeliner is likely to encounter.

At Hollister, about 80 miles southeast of San Francisco the first operating base was established in the summer of 1949. Here, at a railroad siding, an imposing array of machinery was assembled. It had been carefully selected and some of it had been especially designed for the task in hand.

Everything needed in the field, from welding rod to complicated machines weighing many tons, had to be moved from the railroad siding by truck. All of the seventy-million ton-miles by rail, highway, and by-way had to be covered during the course of the project, involving the movement of pipe, equipment and supplies of every sort.

No sooner had the first equipment reached the scene than great bulldozers began working over hills and valleys, carving out a right-of-way and building roads across country from established highways and by-ways to provide access for equipment and loads of pipe.

Next came a giant trencher weighing more than thirty tons which chiseled out a passageway for the pipe and ate its way through tough soil at a rate of a mile a day. Where hard rock was encountered, wagon drills were brought to bear, sinking holes for charges of dynamite. After each blast the debris was cast aside by a backhoe or trench hoe, like a prehistoric monster with an appetite for stone.

The 34-inch pipe came from the South San Francisco plant of Consolidated Western Steel Corporation, whose other plant in Southern California had already been turning out high-tensile-strength pipe of some few inches less diameter for the great Trans Arabian pipe line.

Steel plates from the Geneva Steel Company's plant near Provo, Utah, were fed into rolls that gave them their first semblance of pipe joints. They were longitudinally welded by automatic shield-arc machines, inside and outside. The welded joints were fitted into huge dies which hydraulically expanded them to the required size and roundness, and tested their strength at the same time. After further treatment and severe tests the pipe joints were ready to be sent to the job site.

Meanwhile there was activity in a field near Santa Clara, Calif., where there was a growing stockpile of 34-inch joints of pipe. Thirty feet long and weighing more than two tons apiece, the joints were placed on ramps. By means of an internal clamp, they were brought into perfect alignment and welded together. First of all stringer and filler beads were applied by hand. Then the double-jointed sections were rolled and shunted to an automatic shield-arc machine. This completed the welding operation. With the 30-foot joints solidly combined into 60-foot sections, welding time on the right-of-way was cut in half.

A fork lift loaded the heavy sections onto waiting trailers. Loaded in rapid succession, they ran continuously from the double-joint-

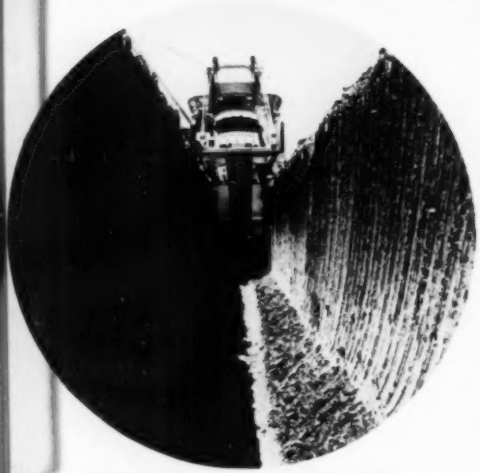
The steepest grade on the "Super Inch" right-of-way. This is on the westerly side of the Tehachapi Mountains, where the pitch is 57 percent. Backfilling is here shown being completed after pipe has been lowered in by equipment working from "shoo-flies".

The 34-inch line was triple-wrapped for extra corrosion protection in a 13-mile stretch of the Mojave Desert where subterranean springs flooded the trench.

At railroad siding especially fitted fork lifts unloaded flat cars carrying 30-foot lengths of pipe.

Setting an intermediate blow-down valve. Control valves were placed eight or ten miles apart.

Old-fashioned feather dusters were used ahead of the coat-and-wrap machine to insure perfect binding, and the feather-duster men did double duty as paint inspectors.



The trench which was 44-inches wide and 5½ feet deep was dug at a rate of a mile or more a day.

ing yard over the highway to Hollister. From there they turned off onto back roads. They toiled around precipitous hillsides and rolled on until they reached the right-of-way, where side-boom tractors waited to unload the pipe and string it alongside the prepared trench.

Construction officially began in July 1949, and the pipe line wormed its way toward San Francisco from Panoche Pass near the San Joaquin Valley. By the end of 1949 that first increment of the pipe line, eighty miles in length, was finished so that it could be tied in temporarily to already existing lines bringing gas from the wells of Kettleman Hills.

The pipeliners next transferred their base of operations to Topock, on the Arizona-California border. Here, on the California side of the Colorado River, the big pipe line began its northwestward course.

The right-of-way passed over the Sawtooth Mountains, ascending fifteen hundred feet in the first ten miles, then across the Mojave Desert, between scattered mountains.

At the head of the building cavalcade giant bulldozers swept gravel and debris aside, smoothing the way for the other machines in

R. L. (Bob) Bowman, general construction superintendent kept in touch by radiophone with various operations which were miles from head end to backfill.

Wrinkle bending machine in action on the pipeline.

their wake. The great ditching machines ground steadily forward. Behind them came backhoes cleaning out the ditch with one-and-a-half yard buckets wherever there was rock. There were big draglines too, with one-and-a-quarter yard buckets.

A tiny tractor with a 42-inch blade crawled into the trench the big machines had dug. The pipeliners called it the "doodle bug." Doing away with the need for laborers with hand shovels, its function was to smooth the floor of the trench to make it ready to receive the pipe.

All this time, flat cars, each carrying a dozen joints of super-inch pipe, were rolling away from the Consolidated Western's plant and twenty or more a day were being received at a yard near Barstow, 170 miles west of Topock.

Ingenious means had been devised to unload the cars. A fork lift scooped up the joints in groups of three. Each load, weighing six tons, was deftly lowered onto inclined ramps or skids, and the pipe rolled into convenient positions for processing.

At this yard near Barstow, as in the yard at Santa Clara, the joints were welded by a combination of hand-welding and machine-welding. Here, however, the automatic machines were enclosed in plywood sheds as protection against strong desert winds and dust. At Santa Clara the pipe had been double-ended into 60-foot sections, but at the Barstow plant a third joint was added, making completed sections each 90 feet long. Thus was the amount of manual welding to be done in the field reduced by two-thirds. The trailers rolled off to the right-of-way carrying nearly two miles of pipe sections every 24 hours.

Now the lining-up and welding crew went to work. Section after section of pipe was brought together and held in alignment by an automatic electrically driven internal clamp. Then the stringer bead was applied. This is the most critical part of the operation. Next comes the hot pass to seal the beveled ends of the pipe sections. The filler bead and the cover pass are made by a procession of follow-up welders to make each welded seam as strong as the parent metal.

On hillsides or where there was to be a change in the line's direction, individual pipe sections had to be bent to conform. This was done right on the spot by a massive wrinkle-bending machine which grips and holds the pipe while leverage is applied by block and tackle. A series of one-degree bends can thus be put into the pipe, making a total bend of as much as thirty degrees in a 90-foot section.

Behind the line-up and welding crew came the cleaning and priming machine, self-propelled and weighing seven thousand pounds. It scraped off rust and scale and coated the pipe with an asphalt primer.

In contrast to this mechanical monster was the antique feather duster. These lowly implements were indispensable, though their purpose was simply to remove dust. The pipe surface must be absolutely clean for the next operation. This is performed by the coat-and-wrap machine which weighs six tons and in rapid succession does four things. First it applies a coat of hot asphalt fed through a hose from a mobile tarpot. Next it wraps the pipe with rag felt. Then it puts on another coating of asphalt, and finally it wraps everything up in kraft paper. All of these steps are to protect the pipe from corrosion.

Big sideboom tractors next come into play. They are no ordinary tractors, but were rebuilt so that their lifting capacity was boosted from 52,000 to 78,000 and even 100,000 pounds apiece. In perfect unison the operators lift the pipe welded into sections up to 4,500 feet in length and lower it gently into its trench.

The final operation is the backfilling of the trench. This signifies that this portion of the line has not only been completed, but has been inspected and accepted by the owning company.

From the pioneers at the head end, the crew and equipment performing all the varied operations were spread over a distance of thirty miles until the finished pipe lay safely buried in its trench, ready to begin its years of service.

Radio telephones were installed in the vehicles of the superintendent and members of his supervisory staff. Thus all of the closely related activities could be coordinated, no matter how far apart they might be, and thus was the crew able to maintain an average rate of progress of a mile and a half or more every day.

From the very outset of the project an airplane was regularly employed by the constructors. Engineers and pipe line superintendents went aloft to study difficult portions of the route so they could determine in advance how best to deal with them. On frequent occasions Bechtel aircraft landed on fields near which the pipeliners were working. Busy executives thus came to the scene to observe progress and help resolve major problems without delay.

Near Bakersfield, 300 miles southeast of San Francisco, a smaller crew of pipeliners went into action in January, 1950. They were working in cultivated fields, where great care had to be exercised to keep from disturbing the land on either side of the right-of-way. Overall right-of-way arrangements had previously been completed by Pacific Gas and Electric and Bechtel scheduled local operations in close cooperation with the farmers to avoid needless damage or inconvenience.

The fields in this area were interlaced with irrigation pipes of concrete which had been carefully charted by the engineers, and wherever one crossed the path the trench was dug out by hand so that the water line would not be broken.

To keep to a minimum the amount of heavy equipment on the right-of-way through cultivated land, the pipe for this stretch was coated and wrapped before delivery. As soon as it was unloaded it was ready to be lowered into the trench. The depth of the trench here was several feet greater than in open country to give ample clearance for the network of irrigation pipes. The lining-up of the pipe was done at the bottom of the trench, where the joints were finally welded together.

Such care was taken by the pipeliners when crossing farm land that in a few short months it was only at an occasional gully or hillside crossing that any trace of the pipe line was noticeable. The right-of-way became indistinguishable from the land on either side of it, and vegetation thrived as before.

Shacks were placed around the automatic welding machines at the field triple-jointing plants as protection against winter cold, and year-round wind and dust.

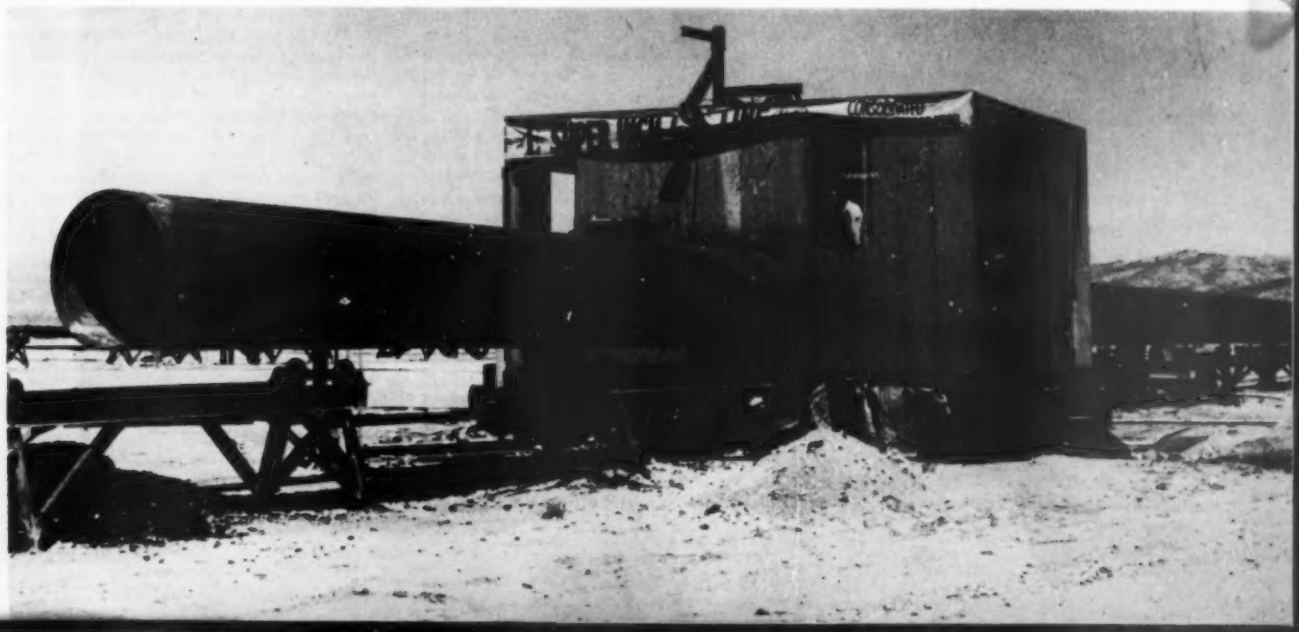


Fig. 1. Fatigue test machine in Hughes Tool laboratories developed to test full-size drill pipe specimens.

Research Reveals Fatigue Results For Pipe-to-Tool Joints

A TROUBLE that has attended the development of rotary drill stems ever since rotary drilling began has been failure at the point of engagement between tool joint and drill pipe. In succeeding years, this type of failure has been greatly reduced by the introduction of better designed tool joints. A number of joint patterns, both screwed and welded, are in use and are giving their users more satisfaction in many cases.

Fatigue failure at the pipe-to-tool joint is not the fault of the drill pipe most commonly used in oil fields today, and which in A.P.I. specifications is known as Grade D; this pipe has a minimum tensile strength of 95,000 psi, and a yield point of 55,000 psi; neither is the failure due to faults of the metal of the tool joint; the break is always in the point of engagement itself. Thus in any tool-joint design the primary objective is to make the pipe-to-tool joint connection stronger than the body of the pipe in order that the strength of the entire string will be limited only by the strength of the body of the pipe itself.

As stated above a number of designs of pipe-to-tool joints are in use, but there has been a lack of means for deciding which types are the strongest. To obtain this information Wm. S. Bachman, of the research engineering department of the Hughes Tool Co., designed a machine for testing the strengths of these joints, and has reported the results to the Petroleum-Mechanical Engineering Conference of the A.S.M.E. (New Orleans, Sept. 25-27, 1950).

Of this work Robert Plunkett of the mechanical engineering dept. of the Rice Institute says: "The data on fatigue strength of full size drill pipe and tool joints presented in this paper are of special interest to the worker on the theoretical aspects of metallic failure. These results, collected over a period of fifteen years from more than one thousand individual full-sized tests made by the Hughes Tool Co. laboratory represent a substantial portion of the fatigue information ever published on the strength of large diameter specimens of any type. This type of information is imperative if we are ever to understand the serious question of size effect."

In designing a machine for investigating the relative strengths of pipe-to-tool joints, Bachman took into consideration the reasons why these connections are subject to fatigue failure, which under oil field conditions generally occur at the last engaged thread of a screw-joint. Generally these failures are due to some form of bending fatigue. The bending of the pipe may be caused by crooked hole, by running the pipe in compression to apply weight to the bit, by slightly unbalanced sections of the pipe turning at high rpm, and general vibrations throughout the string. Each tool joint, its size larger than that of the adjacent pipe, acts as an excellent concentration of mass to set up transverse vibrations. In addition to bending, the joint is also subject to torsion, and superposed on all is tension or compression. This combined load is applied on the last engaged thread of the screw, which acts as a notch and the notch creates a stress concentration point. The notch will reduce the fatigue failure stress below its value for the normal wall section that is without threads.

In order to duplicate in the laboratory the bending fatigue type of loading on a drill stem in the field, Bachman built the large rotating-beam fatigue-testing machine shown in the accompanying photograph (Figure 1). It consists of a spindle for holding a 10-foot section of drill pipe with tool joint installed, a motor for turning the spindle at 300 rpm, and a weight mounted on roller bearings at the end of the pipe to apply the bending load.

For most of the test work a tool joint was installed on a piece of drill pipe with an upset end; and in practically all cases, using the newer type of joints, a break occurred in the body of the pipe before it failed at the tool joint. This information is usually sufficient, that is, the user can see that the connection is stronger than the pipe. To compare various types of joint constructions, use was made of special thick sections of pipe of the same length as the regular drill-pipe test-section, in order to insure failure at the tool joint.

A particular circumstance associated with failure of pipe-to-tool joints is the presence of a notch on the steel, such as the thread of a screw joint. Such a notch is a "stress raiser," or place, where the stress accumulates at a weak point. The weakest of these points is the last-engaged thread of the joint. Therefore an important point in joint design is to overcome the effect of the presence of the last-engaged thread.

The size of the test piece has an important effect on differences in fatigue strength, and it was much to be desired that tests be made on full size specimens in order to eliminate

the variable due to size. All tests reported by Bachman were made on 4½-inch drill pipe. The tool joints which he took into his investigations, classified according to their pipe connections were as follows:

A. Threaded pipe connections.

B. Threaded pipe connections with welded end adjacent to threaded section.

C. Threaded pipe-end connection with supporting land adjacent to the threaded section.

D. Welded on or unitized connections.

E. There are various other minor types which were not considered.

A. Threaded pipe-end connection.

(1) Regular A.P.I. threaded connection. (Figure 2). The failures observed in this joint occurred in the pipe at the last-engaged thread rather than in the body of the pipe. The data show that a reasonable stress value for the normal fatigue curve of this joint at 1,000,000 bending cycles in the test machine is 15,000 psi.

(2) Vanishing thread connection. (Figure 3). There have been several attempts to reduce the notch effect present in the A.P.I. connection by using the various types of vanishing thread designs. The designs shown in Figure 3 are the true vanishing thread and the modified types which utilize a thread relief at the last engaged thread.

Of the types shown, the true vanishing thread has the highest fatigue stress. Tests available indicate the pipe would fail at the last engaged thread at a stress of 15,000 to 19,000 psi at 1,000,000 cycles; however there are not enough tests on any one type to try to establish a definite fatigue limit.

B. Threaded Pipe-End Connections with Welded End.

(1) Regular A.P.I. Connection with Welded End. Drilling contractors in the field first started the practice of welding the ends of the tool joints to the pipe. The first welds were built-up bands of metal 1" to 2" long at the ends of the joints. This was often done by using a copper sleeve around the end of the joint and filling the space between sleeve and pipe with a band of metal.

Following these field welded joints, the present welded type was developed in which two beads are welded in the counterbore at the end of the tool joint and the shoulder machined after welding (Figures 4 and 5). This is presently known as a counterbore weld tool joint.

The weld provides support for the pipe at the end of the tool joint, reducing stress concentration at the last engaged thread. The last engagement between pipe and tool joint then becomes a square shoulder over a heavier part of the tapered pipe upset instead of a thread cut in a thinner portion of the upset. The weld also acts as a seal to prevent corrosive mud from contacting the threads.

The normal fatigue failure stress for the section of the pipe adjacent to the shoulder and weld of this joint is 20,000 psi at 1,000,000 cycles.

C. Threaded Pipe End Connection with Supporting Land Adjacent to the Threaded Section.

These joints are classified as the bucked-on and shrink types (Figures 6 and 7). It should be noted that the thread form is different in each case. The bucked-on joint is screwed on the pipe using a torsional load while the shrink type joint is heated, screwed-on, and on cooling, shrinks until both threads and land tightly engage the pipe. The bucked-on joint utilizes a regular 60° A.P.I. "V" pipe thread. The shrink type has a modified acme thread which provides clearances on the thread flanks. These clearances are necessary to allow for longitudinal shrinkage and to prevent excessive interference between the mating threads in the hot and cold positions.

(1) Bucked-on Type (Figure 6). For the best performance it is necessary to buck the joint on the pipe using a buck-up machine where a controlled amount of torque can be applied. The bucked-on joint is not readily removable, like the shrink-type joint, because it will sometimes gall when bucked-off the pipe. The bucked-on type represents an increase in fatigue strength over the regular A.P.I. joint and protection of the last engaged thread against corrosion. The tests available

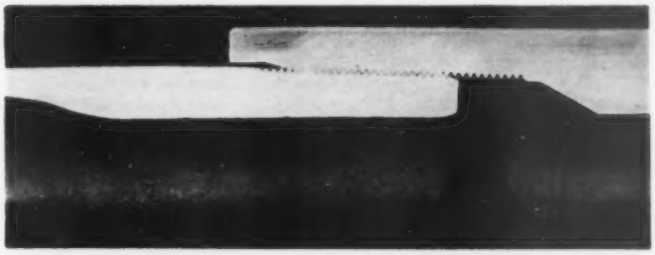


Fig. 2. API threaded connection.

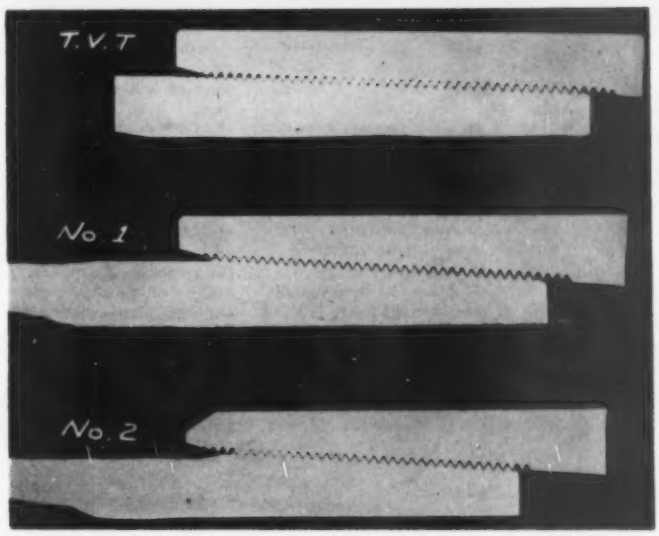


Fig. 3. Vanishing thread connections. Above, true vanishing thread; center and bottom, modified vanishing threads.

Fig. 4. Typical failure in body of 4½-inch drill pipe.

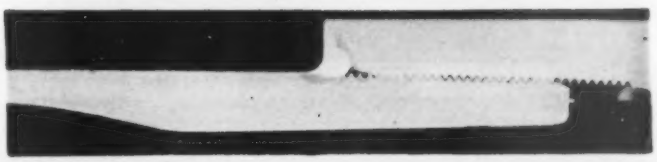


Fig. 5. API threaded connection with welded pipe end.

Fig. 6. Bucked-on threaded connection with supporting land outside of last engaged thread.

on the bucked-on connection indicate that the pipe at the tool joint should have a fatigue failure stress of 18,000 psi at 1,000,000 cycles.

(2) Shrink Type (Figure 7). This type of joint supports the pipe against bending in a similar manner to the bucked-on type, and the last engaged thread is sealed against corrosion. The shrink-on joint has the additional advantage of being removable by heating the joint and quenching the pipe.

A tight fit is assured on the supporting land by designing the correct amount of interference between joint and pipe, and by heating to the proper temperature on installation. The interference between joint and pipe can be greater than in the case of the bucked-on type without the danger of galling the threads or lands when the joint is screwed on the pipe. This eliminates the possibility present in the bucked-on type of slight gall on the threads or lands when the joint is screwed on the pipe. This eliminates the possibility present in the bucked-on type of slight gall on the threads or land, produced during make-up causing a local high spot between pipe and joint. Such a joint would appear to be tight on installation but might loosen in service.

The test results available indicate that the shrink type has a fatigue stress of 20,000 psi at 1,000,000 cycles at the tool joint shoulder which is slightly higher than the 18,000 psi failure stress on the bucked-on type. However, if both joints are equally tight at the shoulder, the stress concentration should be the same, and this difference may be a result of scatter.

D. Welded-on or Unitized Tool Joints.

In an effort to eliminate a threaded-pipe-end connection and still have the physical properties of an alloy steel joint, many attempts have been made to weld the tool joints to the drill pipe.

The problem has been to get a weld consistently strong enough in fatigue strength to eliminate failures at the weld line. This problem has been solved by the flash weld type; however, the test results available on various hand weld designs are not so encouraging.

(1) Hand Welded Types (Figure 8). The test results obtained are for the failures at the weld line and have been derived from more than a half-dozen different designs. These include electric-arc welds as well as acetylene welds. The arc-welded types develop slightly higher fatigue strength values. The joint as shown in Figure 8 is typical of one of the designs tested.

Higher tensile strength electrodes give a higher fatigue strength on hand welds. Building up the last bead greater than the outside diameter and machining off excess metal to clean up the surface of the joints will increase the fatigue strength. A copper backup ring is generally used to eliminate the possibility of burning through to the bore of the joint.

Data on Figure 8 indicates that hand welded joints can be expected to have fatigue failure stress of 15,000 psi at 1,000,000 cycles at the weld line. However, the scatter band for any of the types of hand welded construction is so wide that the reliability of this figure is questionable. For this reason no attempts were made to separate the various hand welded types.

(2) Flash Weld Type (Figure 9). In principle flash welding consists of melting two pieces of metal by electric arcing, at the point at which the weld is to be made, and squeezing these two pieces together in the molten state.

In the case of flash welded tool joints, the joint and pipe are held in alignment in a flash welding machine and a high current applied. This causes arcing across the ends of the tool joint and pipe and subsequent melting of the metal in this area. The current is then stopped, and the joint and pipe are forced together, thus squeezing out the excess molten metal at the weld line. The metal squeezed out is machined off to clean up the welded section.

In fatigue testing flash welded joints, where the test is set up to produce failures at the joints, the failures will always occur in the upset area adjacent to the weld line, but never actually in the weld. The area on either side of the weld line has a slightly lower tensile strength than the weld line itself. This probably accounts for the higher fatigue strength on the weld line.

Another interesting observation is that the fatigue stress is approximately the same, regardless of whether the failure is in the pipe or tool joint side of the weld, even though one material is medium carbon steel, and the other is an alloy steel.

In order to get some idea of the magnitude of the strength of the connection at the weld line, a series of tests were run with a stress-raiser introduced to make the connection break at this point. The stress-raiser used was a sharp 60° notch, ¾" deep, machined in a heavy section weld. With such a notch the fatigue strength at the weld line was still 22,000 psi at 1,000,000 cycles.

This fatigue stress indicates that the actual weld line is as strong as any other sections of the joint, even if a severe stress raiser is present.

E. *Other types of Tool Joint Connections.* The other general types of tool joints commercially available today, are the pressure-weld joints, similar in appearance to the flash weld type, and the integral joints with pin and box threads machined directly in appearance to the flash weld type, and the integral joints with pin and box threads machined directly in heavy upsets on the ends of the pipe. There are no fatigue data available on these types at the present time. The various results obtained are summarized in the accompanying Table 1.

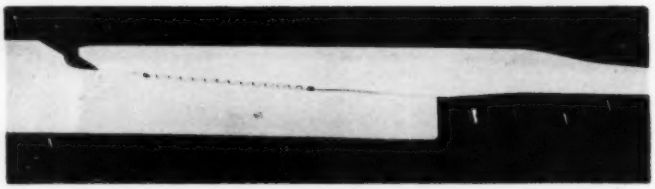


Fig. 7. Shrink type threaded connection with supporting land outside of last engaged pipe thread.

Fig. 8. Hand weld connection.

Fig. 9. Flash-weld connection.

Table I

SUMMARY OF FATIGUE RESULTS*

A summary of the foregoing fatigue values for pipe-to-pipe joint connections at 1,000,000 cycles is as follows:

Item	Nominal Stress for "Normal Fatigue Curve" —psi
Regular API Threaded Connection—Failure to pipe at last engaged thread.	15,000
Vanishing Thread Types — Failure of pipe at last engaged thread.	15,000-19,000
Regular API Threaded Connection with Welded end—Failure of pipe at tool joint shoulder.	20,000
Threaded Connection with Supporting Land adjacent to Threaded Section — Failure in pipe at tool joint shoulder.	
Bucked on Type	18,000
Shrink-type	20,000
Hand Welded Joints—Acetylene and Arc-welded — Failures in Weld	15,000
Flash Welded Joints	
Failures in upset adjacent to weld.	23,000
Failures in weld line with 60° "V" notch.	22,000

*It should be remembered in using this table that the bending moment determines the strength of the joint, not the fatigue failure stress alone. Although the connections have a lower fatigue stress than the body of the pipe, most of the joints are actually stronger than the pipe, because of the additional section in the pipe upset.

Ratios of Success in Wildcat Drilling

By DR. F. H. LAHEE

Dr. F. H. Lahee of the Sun Oil Company, chairman of the Committee on Reserves of the American Petroleum Institute, for years past has compiled and published annually statistics of wildcat drilling in all the principal oil producing areas of the United States. His figures are recognized as authoritative and out of the record of a representative period far enough removed so that the results of discoveries can be fairly measured, he prepared for the Bulletin of the American Association of Petroleum Geologists the following report. It reveals strikingly the very small proportion of wildcat discoveries that lead to a profitable volume of ultimate recovery. It demonstrates as nothing else could the necessity of maintaining conditions that will encourage explorers to assume the high risks involved if reserves are to be maintained at a level that will sustain the rapid increase in consumption. — Editor

FROM the statistics on exploratory drilling which have been compiled every year since 1937, erroneous conclusions have sometimes been drawn. This note is submitted for the purpose of clarifying one of the more important of these conclusions. This can be done most concisely by listing the following facts:

(1) There are five different classes of exploratory hole. We are concerned here with only one of these classes, namely, the "rank wildcats" or "new-field wildcats," so called because they are drilled to look for new fields.

(2) The new-field (rank) wildcats constitute more than 50 per cent of all exploratory holes.

(3) The biggest risk of financial loss in exploratory drilling is in the drilling of these new-field (rank) wildcats.

(4) Because of the fact that available statistics adequately cover only 17 of the states where wildcat drilling was in progress prior to 1946, the accompanying figures apply only to these 17 states, designated for convenience as the "17-states area," but note that within these 17 states more than 95 per cent of all the new-field (rank) wildcat drilling in the United States was done. They are therefore fairly representative of the country as a whole.

(5) In these 17 states the best data on the total estimated ultimate recovery of oil (i. e., total production from date of discovery to date of estimate plus total recoverable reserves remaining on date of estimate) are for the fields discovered by rank wildcatting in the year 1944, 1945, and 1946. For each of these fields there have been at least four years of development history to show the extent of the original pool and how many other pools may be associated with this original pool in the same field.

(6) The new-field (rank) wildcats drilled in these three years (as in any year) may be divided into (a) those which were dry and failed to find any commercial production and (b) those which, although they were "successful" in the sense that they discovered some production, were successful in varying degrees. This is a most important point, and one that should always be considered in measuring the risk in new-field (rank) wildcatting. There is a big difference in whether a new field has a total ultimate recoverable reserve of a million barrels or less; or of 10, or 25, or 50 million barrels, or more. Roughly speaking, and using averages for depth of drilling, number of field-development wells required to drill up a field and number of dry holes drilled to outline the edges of the field, it is reasonable to conclude that a field having a total ultimate recovery of a million barrels is, on the average, near the economic limit. In some districts such a small field will pay moderate profits; in others, there will be a net financial loss; all depending on factors of depth to the "pay" or reservoir, difficulties in drilling, permeability and thickness of reservoir rock, accessibility, and other factors.

(7) Referring now to the accompanying table, and using the total and averages for the years 1944 to 1946, it will be seen that:

(a) In the total number of new-field (rank) wildcats drilled (8696),

8005, or 92.1 per cent, were failures (dry or abandoned soon after completion); 487, or 5.6 per cent, discovered fields with a total ultimate recoverable reserve of less than one million barrels; 204, or only 2.3 per cent, discovered fields with a total ultimate recoverable reserve of more than one million barrels.

(b) Only one well out of every 44 new-field (rank) wildcats discovered a field with more than one million barrels of total ultimate recoverable reserves.

(c) Only one well out of every 243 new-field (rank) wildcats discovered a field with more than 10 million barrels of total ultimate recoverable reserves.

(d) Only one well out of every 967 new-field (rank) wildcats discovered a field with more than 50 million barrels of total ultimate recoverable reserves, that is, what is usually regarded as a major field.

These are figures which spell a very significant story of the risk involved in actual wildcatting. They are better than figures that might be taken from recent statistics, as for example, fields discovered in 1949, because these recent discoveries have not yet had time for development to demonstrate their size and capabilities of production. The figures for 1944 to 1946 inclusive, as given above, may be safely used however as essentially representative of conditions today.

TABLE I

Degrees of Success of New-Field ("Rank") Wildcatting in the 17-States Area[1]

1	2	3						4	5			
Year in which new fields were discovered	Total number of new-field (rank) wildcats which discovered new oil[2] fields	Number of fields discovered in year indicated having estimated total ultimate recoverable reserves of:						Total number of dry new-field (rank) wildcats drilled	Total discoveries plus dry wildcats (2) + (4)	These figures show that, in the year indicated, the ratio of success, in the total number of new-field (rank) wildcats drilled, was:		
		Over 50 million barrels (A)	Between 25 and 50 million barrels (B)	Between 10 and 25 million barrels (C)	Between 1 and 10 million barrels (D)	Less than 1 million barrels Still producing (E)	Less than 1 million barrels Abandoned (F)			For discoveries of fields of 50 million barrels ult. or better	For discoveries of fields of over 10 million barrels ult. or better	For discoveries of fields of over 1 million barrels ult. or better
1944[3]	245	4	1	9	62	152	17	2684	2929	1 in 733	1 in 210	1 in 40
1945[3]	272	2	2	9	42	173	24	2578	2830	1 in 1416	1 in 219	1 to 52[4]
1946[3]	257	3	1	5	64	162	22	2680	2937	1 in 980	1 in 327	1 in 41
Totals of '44 to '46 inclusive	754	9	4	23	168	487	63	7942	8696	1 in 967	1 in 243	1 in 44

[1] This area includes the following states: Alabama, Arkansas, California, Colorado, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. These states included more than 95% of the rank wildcat drilling in the United States.

[2] This figure does not include dry-gas discoveries, nor pools at first thought to be new fields but eventually proved to be connected with old fields, nor does it include a few unimportant discoveries where reliable data were not available.

[3] See Table XI, p. 798, Vol. 33, Bull., AAPG, June, 1949.

[4] Re-appraisal published in June, 1950. Bull., AAPG, Vol. 34, p. 1008.

World's Most Powerful Rig

Quarter boat, mess boat, drilling barge and power barge of Rig 20.

Humble Oil & Refining Company Operates 3,000 Horsepower Drilling Barge in Louisiana Marshes

TWENTY years ago Humble Oil & Refining Co. put into service its first diesel-electric drilling barge in the Lake Washington field in the marsh lands of southern Louisiana. The rig was the most powerful of its day with 250 kw generating capacity.

Today Humble still is drilling in Southern Louisiana, but to deeper levels, and again with the most powerful drilling barge employed in the industry. It's 2,100 kw generating capacity is almost ten times that of the company's first diesel electric rig. The new Rig No. 20 is classed as a 20,000-foot deep hole rig and had completed a 14,000-foot well before being assigned to the Four League Bay field. It has available hoisting power totaling 2,680 hp in addition to the usual auxiliary requirements of such a rig.

As operated in the Four League Bay offshore area the complete rig consists of a boat in which the crew is quartered, a mess boat, the drilling barge on which drawworks and derrick are mounted, and the power barge. There are, of course, launches and fuel and equipment supply boats to keep the operation going smoothly. Only the power barge is new, the derrick and drawworks having been in service previously as a 10,000-14,000-foot rig with less power. The drilling barge is a wood-sheathed, steel barge measuring 120 by 56 feet.

Machinery for the new power barge was purchased as war surplus and mounted on a new 100 by 29.5-foot steel barge built for the company at Orange, Texas, and towed to Lake Washington after being wired by Humble personnel. Design for the barge was developed by Humble engineers.

Three 12-cylinder 1,080 hp two-cycle diesel engines directly connected to 1,200 kw generators which supply power for Rig No. 20 and to 60 kw auxiliary generators were installed in destroyer escort vessels during World War II. After being purchased from government war surplus stocks the diesels were reconditioned and the generators modified and put into operating condition. An auxiliary diesel-electric set is used as a starter for the large engines.

Normally two of the diesel-electric units are employed in the rig operation while the third is kept as a stand-by. The extra power is available for fast, smooth operation and for hoisting from greater depths. The drawworks is powered by a 1,000 hp, 525 volt dc motor which can be operated momentarily at more than 250 percent of rated torque for emergency use in pulling a heavy load of pipe. When operated in parallel the three main generators can deliver 2,680 hp to the drawworks motor shaft for hoisting in addition to the 180 kw available for auxiliaries from the smaller generators previously mentioned.

The three main generators may be used separately on any of the motors powering drawworks, mud pumps, rotary table or core reel. Normally only one unit is driven from one motor for control considerations. Speed of any pump or other unit is controlled by voltage applied to the armature of the motor connected to it. The diesel engines are equipped with governors which prevent overloading at any speed.

Switches connecting generators with various units are installed on the new power barge. Once these connections have been made all further controls are in the hands of the driller. The driller has an emergency stop which will disconnect all power units simultaneously among other safety devices. Indicators at the drilling position show rotary speed and rotary and drawworks torque. A highly sensitive amplidyne brake system has been incorporated in the rig. With this system it is possible for the driller to set the rheostat for a desired hoisting speed and run a considerable number of stands at a constant speed without further adjustment. Full braking power may be applied momentarily by a hand control when slips are set or it is desired to retard fall of the block.

Principal motor equipment on the drilling barge consists of the 1,000 hp drawworks motor, two 600 hp mud pump motors, a 300 hp rotary table motor and a 300 hp coring reel motor. In addition there are a multiplicity of small motors with an aggregate of 62 hp on the drilling barge to operate various services such as the blowout preventer, shale shaker, mud mixer, washdown pump, etc.

On the power barge as previously mentioned there are three 1,200 kw main generators and three 60 kw auxiliary generators, in addition to the 25 kw starter unit. Motors installed for various services on the power barge total about 100 hp for pumps, air compressors, fans and other loads.

The entire equipment is laid out in such a manner as to provide easy access and thus permit safe, trouble-free operation.

On derrick floor roughnecks reach for elevators to lift the five-inch drill pipe. →

Inside the new power barge are three 1,000-hp diesel engines and electric generators. Amplidyne control units are in front of the operator's desk.

Push buttons on the controls panels of Humble Oil & Refining Company's Rig 20 power barge start and stop the diesel electric generator sets which supply the rig's power. ←

Driller pulls one of the master control switches on the rig floor. Switches are for connecting rotary and mud pumps. →

New Tool for the Wildcatter

A NEW aid to the search for oil which is considered of special value to the wildcat driller has been developed by the research laboratory of The Carter Oil Company after two and a half years of study and experimentation. It is called the Dip Logger and its function is to measure the slant of rock formations encountered in drilling.

In the ordinary course of events the wildcatter drills many more dry holes than producers. The function of the Dip Logger is to add to the driller's information as to the character of successive formations, their depth and rate of inclination. Combined with the knowledge obtained by coring this may give valuable hints as to the direction in which to locate the next test in case of a dry hole or if a producer as to where it is advisable to drill the next well and develop the field.

As every driller knows there is considerable variation in the character of different strata their hardness and resistance to penetration and erosion. As a result the typical well hole is not a uniformly smooth bore, such as is made in drilling through wood or metal or any substance of uniform texture. Instead its sides are marked by irregularities with hollows where the circulation of the mud has carried away the softer parts of the wall while the harder portions project in small ledges.

Central feature of the Dip Logger is the indicator probe, a tube 15 feet in length and 4½ inches in diameter inside which various instruments can be placed. To the lower end of the probe are attached three metal arms so positioned that when they are released within the hole their extremities are 120 degrees apart. To make a recording the tube is lowered to the bottom of the hole, a spring releases the arms and as the logger is pulled upward at the rate of 75 feet a minute the arms revolve their tips being held firmly against the wall of the drill hole by springs and each records its course on tape at the top of the hole. By measuring the vertical distance between corresponding peaks and valleys on the records the degree of dip of the formations can be computed.

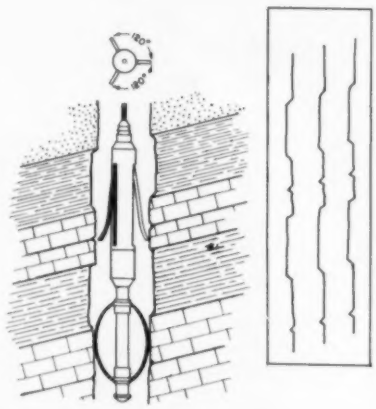
A magnetic compass in the probe also records the direction of the dip. Another complicated device, an inclinometer, makes a continuous record on deviation from vertical of the hole itself and provides correction data to get true dip.

The Logger has other uses. The operator on the surface can watch his instruments and see the motion of the arms, the direction of the compass and direction of tilt. Because of the speed and ease of operation he can run two surveys for a quick double check.

Involved mathematical problems are eliminated through use of computing graphs, converging line charts and the mechanical brain of the computer.

Extensive testing preceded release of the apparatus for use. Thirty-one wells were logged and records obtained on more than 230,000 feet of open hole. The logs included formations on the Gulf Coast, in West Texas, Oklahoma, Illinois and a completely folded and faulted section in Wyoming. More than 1100 dips showing from zero to 75 degrees of slant were computed during the tests. In further checking dips were found in agreement with known subsurface geology.

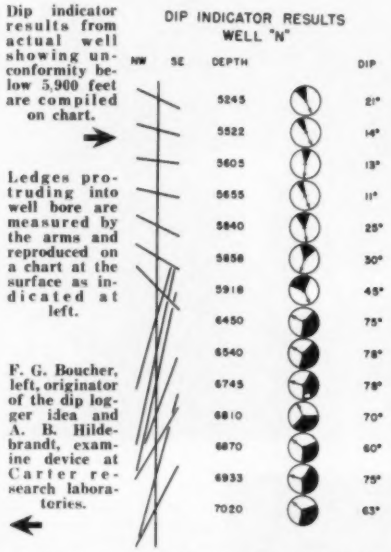
Because of the speed with which its results can be obtained and the information it provides, the new tool is expected to contribute importantly to the search for additional petroleum reserves.

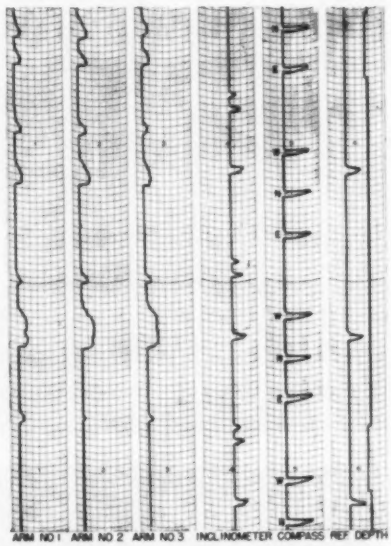


Dip indicator results from actual well showing unconformity below 5,900 feet are compiled on chart.

Ledges protruding into well bore are measured by the arms and reproduced on a chart at the surface as indicated at left.

F. G. Boucher, left, originator of the dip logger idea and A. B. Hildebrandt, examine device at Carter research laboratories.





Sample dip log shows profiles, incline, compass reading and the depth.

Dip logging equipment. Probe is at side of reel truck.

International news and notes

Production Rises Seven Percent

Anglo-Ecuadorian Oilfields, Ltd. produced 245,927 tons of crude last year, an increase of seven percent over 1948, Lord Forres, the chairman told the annual meeting in London. Shallow oil development in the San Tomas area has proved a success and well sites permit drilling at the present rate for some years to come. Deep drilling has proved disappointing. During the year 119,206 feet were drilled as against the previous figure of 67,598 feet. The company completed 55 wells, put two C,50 rigs into use but added no new rotary rigs. A deep drilling test in the 1945 concession was abandoned at 8,762 feet. A second test well is being drilled. The southern part of the El Oro concession has proved surprisingly unproductive of worthwhile indications. Core test wells are now planned in other parts of this large concession based on geo-chemical survey.

South American Oil Congress

The first South American Oil Congress will meet in Montevideo, Uruguay, March 12-16, 1951. Organized under the auspices of the South American Institute of Petroleum the purposes of the Congress are to promote the production of oil and its by-products in South America, to consider methods of efficient operation of the industry, to investigate the possibility of increasing the exchange of fuels between Latin American countries and to encourage the exchange of ideas and friendly association among members of the oil industry.

The organizing committee of the Congress consists of Carlos R. Vegh Garzon, chairman; German E. Villar, secretary; Col. Tydeo Larre Borges, treasurer; Salvador Masson and Ernesto Pelufo.

A. L. Walsh

Shell-Mex and B. P. Appointments

A. L. Walsh has been appointed secretary of Shell-Mex and B. P. Ltd., London, in succession to H. K. Stein, who has retired. Mr. Walsh was admitted as a solicitor in 1935 and served the Eagle Oil and Shipping Co. in that capacity from 1939 to 1950 except for five years of war service in the Navy. He joined Shell-Mex and B. P. in April of last year.

A. J. Foster has been made general supplies manager of Shell-Mex and B. P. in charge of purchases, supplies and transportation.

Richard C. Harris

Atlantic Appoints Resident Venezuela Manager

The Atlantic Refining Co. has appointed Richard C. Harris as resident manager of the company's operations in Venezuela. He will be stationed in Caracas. Mr. Harris first joined Atlantic in 1938 as resident geologist in its foreign producing department in Havana. He was named chief geologist and transferred to the company's headquarters in Philadelphia on May 1, 1941, where he has served until his present appointment.

To Assist Burmese Government

The Burmah Oil Co. Ltd. and the Burmese Government are engaged in consultation regarding a plan whereby the company will assist in reviving the oilfield area. Disturbed conditions have seriously limited Burmese output while lack of skilled technicians and other reasons have killed plans for large scale nationalization of the oil industry. Instead the government is to cooperate on a 50/50 basis with the former owners. The Burmah Oil Co. is understood to have shipped considerable amount of refinery equipment to the Chauk oilfields, where some 40 percent of the total Burmese output is refined. They are also to resume drilling in the Chauk area to maintain the volume of production at this field.

Stocks of Petroleum Products

The Brazilian Government has decided to permit immediate stockpiling of essential materials to the value of $150 million in view of the tense international situation. In the case of petroleum products the problem presents exceptional difficulties. Existing storage capacity is only sufficient for 1,115,000 metric tons, or one-quarter of annual consumption. One company estimates the cost of doubling capacity at $33 million. Throughout the last war Brazil was only able to obtain 98,000 tons of merchandise monthly towards her minimum needs of 600,000 tons. Unless the international atmosphere clears before the new president assumes office on January 31 it may have the effect of accelerating a decision as to the 1948 Petroleum Bill. Only a powerful oil industry will effectively safeguard Brazil's interests in the event of war, as she could not rely on imports of crude for local refining.

D. H. Joyce Appointment

D. H. Joyce has been appointed assistant development manager of Shell-Mex and B. P. Ltd. He has been a member of the company for 26 years. Last summer he was one of the representatives of the Traders' Co-ordinating Committee on transport in the productivity team which toured the United States to study freight handling and palletiation.

Col. E. J. Vella

Celebrates Golden Anniversary

Esso Standard (Malta), Ltd., recently celebrated its fiftieth anniversary at a dinner for government and industry leaders. The dinner was attended by R. P. Bolton, shareholder's representative for Standard Oil Co. (N.J.) who presented a plaque, and P. T. Lamont, coordinator of marketing for the New Jersey Standard.

The Malta company is one of the smallest of the Jersey subsidiaries with only 43 employees. It has, however, had as strenuous a history as any oil company during the 30-month siege of World War II.

Col. E. J. Vella, general manager for the past 12 years and an employee for 42 years, was in charge when the island first was bombarded in 1941. During the bombing the company's storage facilities were destroyed, but not before Col. Vella and his staff had transferred gasoline and other products into barrels and had dispersed the barrels into tunnels, caves and quarries. During the war 20 percent of the company's personnel served in the armed forces. For their contributions to defense, General Manager Vella and his assistant, Lieut. Col. G. T. Curmi, were made Officers of the Order of the British Empire.

Since the war the company has constructed new storage facilities and now operates two bulk stations, and competes with two other oil marketing companies to serve the 300,000 or more residents on Malta.

Recent estimates list approximately 6,000 passenger cars on the 95 square miles of Malta. Trucks number about 2,400, buses about 560, and motorcycles 1,271. There were less than 20 tractors in use last year.

No service stations are operated by Esso Standard, almost all deliveries being made to independently-owned service stations or sold to distributors who deliver the product to consumers. Horse-drawn carts still are used by some of the retailers to cover their routes.

I. G. Davis

Mene Grande Personnel Changes

R. L. Boggs, vice president and director of Mene Grande Oil Co. has been transferred to Gulf Oil Corp., New York, and I. G. Davis, division manager of Western Venezuela operations, has replaced Mr. Boggs in Caracas. George L. Lockett, chief geologist, succeeded Mr. Davis in Maracaibo, and H. J. Funkhouser, formerly assistant to Mr. Lockett, moved up to chief geologist. Arthur P. Portas, general counsel and secretary of the board, resigned from active service as head of the legal department and was succeeded by Andrew Ellison.

Mr. Davis graduated from the University of Texas in 1929. After oilfield experience in Michigan and Texas, he went to Venezuela in 1935 as a geophysicist for Gulf Research & Development Corp. and four years later joined the geological department of the Mene Grande Oil Co. at Maracaibo. In 1940 he was transferred to headquarters at Caracas, but six years later he returned to Maracaibo as assistant to the division manager. He became division manager in 1948, a position he has held until his present appointment as vice president and director.

Reach Agreement with British

Socony-Vacuum Oil Co. and Standard Oil Co. (N.J.) have concluded an agreement with the British government under which the American companies will be accorded equality with British and British-Dutch companies in their activities in Sterling territory. Basis of the agreement is that the American companies keep the dollar cost of their oil on a par with that of British and Dutch companies.

To accomplish this, Anglo-American Oil Co. will advance the completion date of the 110,000 barrel refinery now being built at Fawley and later will expand its operations to include production of lubricants and tractor fuel. Anglo-American has arranged to purchase crude for Fawley from Sterling sources and is building up its British flag tanker fleet by placing orders for four new super-tankers in addition to the two now on order in Britain. By 1954 Anglo-American will require very little oil except that refined at Fawley.

Socony-Vacuum recently entered a partnership arrangement with William Cory and Sons, Ltd., under which it will increase its lube production in England. A plant is to be built by the partners at Coryton on the Thames some 25 miles from London. This plant will reduce the dollar cost of importing finished oils to Britain.

Iraq Company's Production

Production reported by Iraq Petroleum Co. for the month of December 1950 in the Kirkuk field was 618,183 long tons, an average 156,818 barrels daily. Qatar in the same month produced 175,437 long tons or approximately 42,445 barrels daily.

Venezuela Production

Venezuela's production during October and November established new monthly records, but January promised to be a still bigger month. Daily average production by operators for the week ending January 15 was as follows:

Company	Western Venezuela	Eastern Venezuela	Total
Creole	561,705	143,401	705,106
Shell Co.'s	492,907		492,907
Mene Grande	60,656	205,363	266,019
Texas-Mercedes	14,696	32,045	46,741
Socony		47,045	47,045
Atlantic		21,081	21,081
Richmond	10,906		10,906
Sinclair		11,064	11,064
Pantepec		11,205	11,205
Phillips		5,761	5,761
BCO, Ltd.	957		957
	1,141,827	476,965	1,618,792

Daily averages for the months of November and December are compared below. It is worthy of note that October's production was 25,000 barrels per day more than September's, while September of 1950 represented an increase of more than 150,000 barrels per day over September 1949.

The oil industry made an installment payment of $30,000,000 to the Venezuelan government in January, on taxes incurred during the year 1950. Final settlement of the account is held up pending agreement on a new formula for calculating the government's per barrel royalty. It is estimated that the total industry payment will be about $300,000,000, approximately one half in income tax, the remainder in royalties and other taxes. This sum represents about 60 percent of the total fiscal revenue. Another 20 percent of Venezuela's income derives indirectly from the presence of the industry in the country.

A new blanket labor contract governing most phases of worker-company relations will be forthcoming in Venezuela soon. The former three-year contract expired in February, and discussions between industry and labor spokesmen have been going on since early January, with the government mediating between the two parties. A governmental fact-finding commission which has been investigating disputed points (particularly, commissaries and wages) has turned in a report which is serving as one of the bases of discussion.

The expiring contract, the first of its kind in the oil industry, carried stipulations covering not only wages and working conditions but practically all relationships between workers and the industry, such as the supplying of foods, in isolated areas, through commissaries. There is a possibility that the new contract will tie wages to price indexes.

As part of a government program of administrative reform, a new Ministry of Mines is being set up under Dr. Santiago Vera Izquierdo. Oil matters, formerly handled by a dependent agency of the ministry of Development, will now come under the jurisdiction of a Division of Hydrocarbons which, with a parallel Division of Mines, will be one of two principal agencies of the new Ministry.

In announcing the appointment of Dr. Edmundo Luongo Cabello to head a bureau to study oil and mining economy, the newly-created Minister Vera referred to "highly satisfactory" results obtained by the special mission, headed by Dr. Luongo, which visited the Middle East oilfields for Venezuela last year.

Other appointments within the new Ministry include the following: Administration, Oscar Garcia; Hydrocarbons, Dr. Gustavo Thery Fombona; Mines, Dr. Carlos Paradisi; Geology, Dr. Armando Schward; Chemical Research, Dr. Prado. Dr. Martorano Batisti, long-time head of the Office of Hydrocarbons under the Ministry of Development, will occupy an important new post in Washington, as Petroleum Counselor of the Venezuelan Embassy.

Alberta Denies Gas Export

The government of Alberta, Canada, has rejected applications for permits to construct pipe lines for the transportation of gas outside the Province. The government's position is that not until gas reserves sufficient to meet Provincial needs for the next 30 years are definitely assured should shipments to outside points be permitted. When that point is reached pipe line permits will be considered.

To Drill in Lower California

First well to be put down in Lower California, Mexico, will be drilled by Pike Drilling Co. of Los Angeles, it is announced by Petroleos Mexicanos in Mexico City. The test will be located in the municipality of Don Ignacio on the dividing line between the northern and southern territories of Lower California. Decision to explore the area is based on surveys made by Mexican geologists.

D. A. C. Dwedney

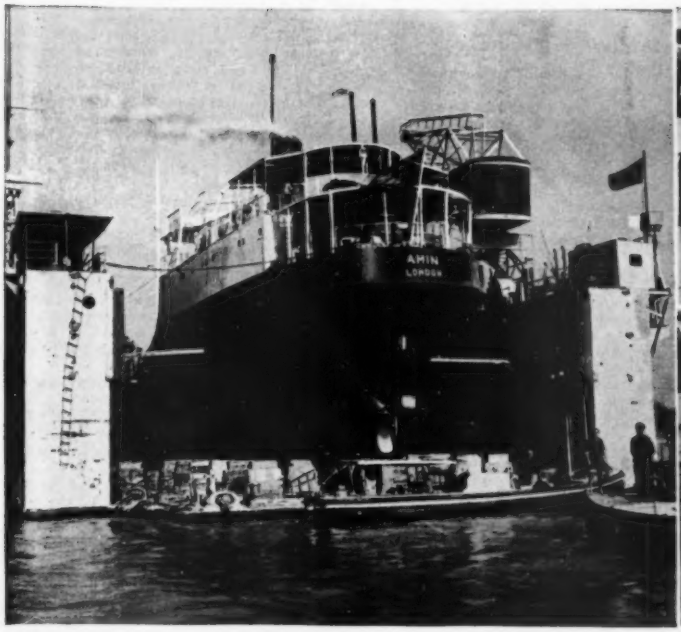
Anglo-American Coordinator

Anglo-American Oil Co. Ltd. of London announce that D. A. C. Dwedney, since 1949 research manager of Esso Development Co. has been appointed co-ordinator of refinery operations. In this position he will be responsible for co-ordinating all the refining and manufacturing activities of the company with other departments and affiliates. Mr. Dwedney became associated with the Esso organization in 1936. Before that time, he spent several years in the Middle East, as a refinery chemist. During the late war he served as a staff officer in the Royal Air Force with the rank of Wing Commander.

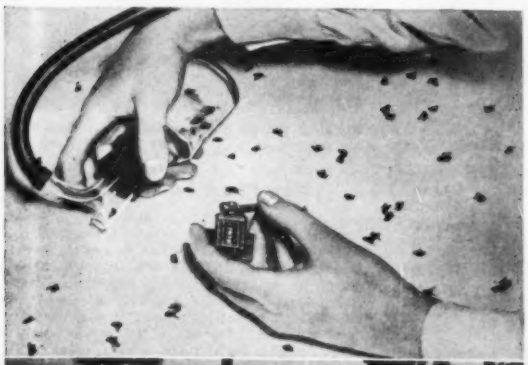
VENEZUELA CRUDE PRODUCTION
(Barrels Daily)

Company	October 1950 Western Venezuela	October 1950 Eastern Venezuela	October 1950 Total	November 1950 Western Venezuela	November 1950 Eastern Venezuela	November 1950 Total
Creole	547,703	146,059	693,762	553,570	144,880	698,450
Shell Co's.	489,139	—	489,139	492,563	—	492,563
Mene Grande	61,748	213,102	274,850	57,938	212,374	270,312
Socony	—	41,608	41,608	—	44,652	44,652
Texas-Mercedes	16,497	28,124	44,621	16,065	28,157	44,222
Sinclair	—	11,553	11,553	—	10,989	10,989
Pantepec	—	11,669	11,669	—	11,177	11,177
Atlantic	25	18,830	18,855	11	18,803	18,814
Richmond	16,481	—	16,481	14,053	—	14,053
Phillips	—	7,344	7,344	—	6,337	6,337
BCO, Ltd.	945	—	945	1,208	—	1,208
	1,132,538	478,289	1,610,827	1,135,408	477,369	1,612,777

Behind the Scenes



Auxiliary services of all kinds are involved in Anglo-Iranian's world-wide oil operations ; such as dry-docks, laundries, employees' newspapers in Persia, insecticide-testing and scientific film-making in England. They all contribute towards Anglo-Iranian's oil production—255,000,000 barrels in 1949.



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First and Biggest

oil producers in the Middle East since 1912, Anglo-Iranian Oil Company and its associated companies also operate twelve refineries in Europe, Middle East and Australia ; their sales organisation includes major marketing or supply interests in Europe, Asia, Africa and Australasia, with international ships' bunkering and aviation services.

BP

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S. S. British Adventure

S. S. "British Adventure" Launched

The first of six 28,000 ton tankers on order from various yards in Great Britain by the British Tanker Co., shipping organization of the Anglo-Iranian Oil Co. Ltd., was launched recently by Mrs. Fraser, daughter-in-law of Sir William Fraser C.B.E., chairman of the parent company, at the Barrow-in-Furness Yard of Vickers-Armstrong Ltd.

This is the first tanker which has been constructed at this yard for 25 years, although the first oil carrying ship, the "Hainault" built there, was launched in 1887, and is still in service carrying molasses in Cuba. This was a three masted, fully rigged ship 240 feet in length and carrying a dead-weight of some 2500 tons. The first steam driven petroleum tanker built there was launched in 1893.

At present the same yard is preparing to construct two 31,000 ton tankers for Mr. Stavros Niarchos (The Northern American Shipping and Trading Co. (London) Ltd.), as well as two of a similar capacity for the Standard Oil Co. (N. J.).

The "British Adventure" is the largest tanker thus far launched from a British yard. Principal dimensions are: length over all 643 feet, length B.P. 610 feet, breadth moulded 81 feet, depth to upper deck 44½ feet, dead weight on summer draught 28,100 tons, sea speed 15 knots. She has 30 cargo oil tanks, three abreast in the width of the ship, and is all welded with the exception of the seams of the bilge strake and the upper deck stringer bar.

Three turbo-driven pumps of 850 tons per hour capacity each are installed, together with two stripping pumps, one steam and one electric driven. The vessel is propelled by a single four-bladed 21 foot diameter screw, driven by a set of geared turbines of Parsons' type Pametrada design, developing service power of 12,500 shp. and a maximum power of 13,750 shp with propeller revolutions of 112 and 116 respectively. The two water-tube boilers are of Foster-Wheeler type "D", working at 450 lbs. pressure with 750° F. at superheater outlet.

Speaking after the launching, Sir William Fraser stated that the British Tanker Co. were already negotiating for the building of larger tankers, i.e. four of a capacity of 32,000 tons each. These in addition to the 37 tankers presently under construction for the company, 25 of which are being built in British shipyards.

Completes Second Producer

Sinclair Oil & Refining Co. has completed Guere No. 2 in the State of Anzoategui, Eastern Venezuela. This well, which is approximately ⅝ of a mile northwest of Guere No. 1 brought in last October, produced at the rate of 456 barrels daily of 33.6° gravity oil through a ¾-inch choke. Production was obtained from a depth of 7846—66 feet. Three other potentially productive sands were encountered in drilling this well, none of which has been tested. Both wells are located on a 15,500-acre concession.

Pemex Drilling Report

An overall drilling report released in Mexico City by Petroleos Mexicanos shows two Pemex rigs and five belonging to foreign operators are working in the northern Tampico district. Eight Pemex rigs and seven foreign-owned ones are working in the southern Tampico district while 11 Pemex rigs and two foreign-owned ones are drilling the Poza Rica area. Nine Pemex rigs and three foreign-owned ones are operating in southern Veracruz while Pemex is using six rigs to rework wells—four of them in Poza Rica and two in the Southern Zone.

Brazilian Oil Developments

The National Petroleum Council of Brazil announces the discovery of another oil field in the Reconcavo district of Bahia. The area is situated between Pojusa and Catu, alongside the railway, 39 miles north of Salvador, the State capital. The Agua Grande well in this district was tested at the end of December, and revealed a high pressure layer at a mean depth of 4,200 feet, indicating a new structure with promise of a good yield of petroleum. During 1950 the Petroleum Council drilled 34 wells, of which 29 are producing oil, in the Reconcavo district of Bahia.

Halliburton Enters Reynosa Area

The Halliburton Oil Well Cementing Co. has completed an operating agreement with Petroleos Mexicanos which had been under discussion for the past six months. Under the new contract, Halliburton will move two crews and equipment into the Reynosa area in the near future.

To Complete Products Line

Petroleos Mexicanos expects to complete the products pipe line across the Isthmus of Tehuantepec, during May, Senator Antonio J. Bermudez, director general of Pemex has announced. Initial use of the 10-inch diameter, 155-mile pipe line will be to transport gasoline, kerosine and diesel oil from Minatitlan, refining center on the east coast, to a terminal at the port of Salina Cruz for supply of Mexican west coast points.

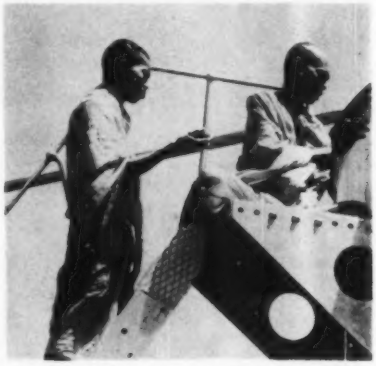
The line is designed to handle 15,000 barrels of products daily. Later, when a projected refinery on the west coast is built, the pipe line will be converted to transportation of crude oil at the rate of 30,000 barrels a day. The additional capacity will be obtained by the addition of a pumping station midway of the line. The line will save well over a million dollars a year in transportation costs and will release approximately 200 tank cars.

Only one pump station, at Minatitlan, will be used for the products line. It will have two reciprocating 15,000 bd Wilson-Snyder duplex pumps, operated by two 255-315 hp Cooper-Bessemer diesel engines. The other will be used as a spare.

At Salina Cruz the terminal facilities will include 430,000 barrels of tankage capacity.

Present and expected consumption of light petroleum products on the Mexican Pacific Coast is shown as follows:

	(In barrels per day) 1950	1955
Gasoline	4,300	6,000
Kerosine	1,500	4,500
Gas oil	3,300	4,500
Total	9,100	15,000



Buddhist priests bless equipment at Don Muang Airport.

New Plane Fueling System

Following local Thai custom, when Standard-Vacuum Oil Co. recently opened a new bulk plant and hydrant aircraft refueling system at Don Muang Airport, Bangkok, company officials consulted an astrologer for a propitious opening date and arranged for Buddhist priests to bless the installation and equipment. Priests sprinkled holy water at the gate of the company's new 75,000 gallon bulk plant which supplies the hydrant system and on principal equipment items.

Air Chief Marshal Fuen R. Riddhakani, commander-in-chief of the Royal Thai Air Force, officially dedicated the new system, emphasizing its importance both to the military and to commercial air lines operating out of Don Muang. Three hundred guests including Thai, United States and British air, naval and military attaches, diplomatic representatives and commercial air officials saw a demonstration of the hydrant system and were conducted on a special tour of the installation and the adjacent bulk storage plant, both operated by an all-Thai staff.

The new hydrant system is capable of refueling all types of aircraft at the rate of 150 gallons per minute, nearly three times faster than the average tank truck delivery. Fuel is pumped through a six-inch pipe line to the airport aprons where two hose-carts pick it up from any of 13 outlets and meter it into the planes.

General view of the Chosen Oil Co. refinery at Wonsan in North Korea after it was attacked by United Nations bombers. The plant formerly had a capacity of 5,000 barrels daily.

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Oil company staff changes

Louis B. Wells

LOUIS B. WELLS has been made manager of refineries of Sun Oil Co., a new position. He has been manager of the Sun refinery at Marcus Hook where he joined the refining department in 1923 as a yield clerk. He became refinery superintendent in 1944 and manager in 1949. He will continue to maintain his headquarters at Marcus Hook, reporting directly to vice president C. H. Thayer.

Mr. Wells is succeeded as Marcus Hook refinery manager by Charles E. Maschal, another veteran employee at this plant. Mr. Maschal joined Sun as a still fireman in 1933. After a period of several years as technical engineer and operating assistant he was made assistant superintendent in 1944, and assistant manager in 1949.

FORREST M. DARROUGH, a member of the board of directors of The Carter Oil Co. since 1944 has been elected a vice president. In addition to the executive responsibilities of the new office, Darrough will continue in his present capacity as general counsel of the company and head of its legal department. He has been with the company for 20 years.

WALTER H. PORTH, manager of the international division, A. O. Smith Corp., Milwaukee, Wis., has returned from a twelve months' trip through most of the Marshall Plan countries of Europe, also the Middle East, during which he visited A. O. Smith's old distributors and appointed new ones. He also was engaged in the procurement of some materials and equipment for A. O. Smith, thus contributing to the supply of dollars for U. S. exports.

GEORGE S. KOCH has been appointed head of the tax department of Standard Oil Co. (N.J.) succeeding Maxwell E. McDowell who has retired for reasons of health. Mr. Koch has been with the company since February, 1935, when he was employed as a lawyer for the tax department. He became assistant head of the department in June, 1945. Mr. McDowell has been with Jersey Standard since 1930 and has headed the tax department since July, 1933.

PROF. V. N. IPATIEFF of Universal Oil Products Co. was unanimously elected an honorary member of the Societe Chimique de France at a recent meeting of the general assembly of the society. He is director of the Ipatieff High Pressure and Catalytic Laboratory in the Technological Institute of Northwestern University.

HERBERT E. SCHNUR has been promoted to assistant comptroller of The Texas Co. Mr. Schnur joined Texaco in 1930 as an accountant at the Houston office. He has traveled extensively in the United States and abroad as a company auditor. In 1942 he entered the Army as a private and was discharged in 1946 with the rank of captain. He won the Legion of Merit for work in connection with enemy oil intelligence.

H. J. MONNIK, chief engineer of Catalytic Construction Co., will be project director of Catalytic's atomic energy division, which is undertaking the design of a new uranium ore refinery for the New York Operations Office of the U. S. Atomic Energy Commission. The estimated completion cost of the refinery is $10,000,000.

Mr. Monnik has been chief engineer and director of the Catalytic Construction Co. since its formation in 1946. Prior to this he had been with the Sun Oil Co. in its engineering department for 15 years.

A. C. Long

A. C. LONG, vice president of The Texas Co. in charge of foreign operations in the eastern hemisphere, has been elected an executive vice president with headquarters in New York. He will be responsible for all foreign operations in both eastern and western hemisphere.

Mr. Long joined The Texas Co. in 1930 and the following year become general manager in Ireland. Later he was manager of the Dutch subsidiary at The Hague until 1940 when he returned to the United States. After five years of domestic marketing assignments, except for 14 months in government service, he became manager of the foreign sales division. In 1946 he was made assistant to the vice president in charge of foreign operations.

For nearly two years, in 1947 and 1948 he was in charge of marketing west of Suez for California-Texas Oil Co., Ltd. He returned to Texaco in November 1948 to become assistant to the chairman. In 1949 he became vice president in charge of foreign operations, and in 1950 a director.

R. A. SAUNDERS, resident engineer for Anglo Saxon Petroleum Co. at Suez, has retired after 27 years with Shell companies. He has joined an engineering firm at Port Said.

JOHN SHAW has been elected an assistant treasurer of Gulf Oil Corp. He will be responsible for cash disbursements from the headquarters office, general banking, and other matters of a domestic financial nature, reporting directly to Mr. H. R. Moorhead, Jr., Treasurer.

WILLIAM H. SCOTT has been promoted to executive assistant manager of the purchasing department of Standard Oil Co. (Ind.). He joined Standard in 1929 as a design engineer at its Whiting, Ind. refinery. In 1938 he was transferred as assistant buyer to the purchasing department and was advanced to buyer in 1949.

A. N. KERR, one of the "fathers" of the liquefied petroleum gas industry, has been presented with a distinguished service life membership in the Liquefied Petroleum Gas Association. Mr. Kerr heads the Imperial Gas Co., Los Angeles. His experiments in 1910-11 at Sistersville, W. Va., had an important bearing on the birth of the LP-Gas industry. Looking for a way to tame the "wild gases" that were then a major headache and waste product at the nation's oil fields and refineries, he devised a crude compressor which recovered enough liquefied gas to heat a chicken coop.

E. F. BATTSON, vice president and regional manager for Continental Oil Co. in the Rocky Mountain area, has been transferred to Houston as administrative vice president. He is succeeded at Denver by J. W. Liddell, formerly eastern regional manager at New York.

W. C. MacMILLAN has been elected senior vice president of Continental Oil Co. with headquarters at Houston. He joined the Continental geological department more than 22 years ago. He was elected vice president in charge of production in 1943, administrative assistant to the president in Jan. 1949 and executive vice president the following September.

W. F. DAU has been elected a director of Sinclair Oil Corp. to fill the vacancy caused by the recent death of William P. Philips. Mr. Dau joined Sinclair in 1917. He was elected vice president and assistant treasurer in 1943 and in June of 1949 he was elected treasurer, which position he now holds.

W. F. Dau

Drilling with Air

- IT'S **NEW!**
- IT'S **PRACTICAL!**
- IT'S **ECONOMICAL!**

FAILING 1500 Holemaster Drill being used on shot hole project in Texas.

DRILLING WITH AIR has passed the experimental stage. Now it has been definitely determined that in arid areas, where water for drilling presents a continuing problem, excellent footage can be had by using air pressure to remove the cuttings from the hole.

FAILING engineers have thoroughly tested air drilling methods and results in the field. They have concluded:

1. No worry over water supply problems when drilling with air.
2. No problems of lost circulation in cavernous areas.
3. Hole costs are lower; there is much less idle rig time.
4. Water trucks are eliminated from equipment list.
5. Life of rock bits is increased noticeably.
6. Drilling speed is as great as, or greater than, when water is used.
7. FAILING standard type rigs can be quickly converted to air drilling.

CAUTION: Drilling with air is not recommended for all areas. It is suggested that you check with FAILING engineers to determine if this new method fits your particular problem. Full information gladly furnished at no obligation to you.

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WEST COAST & MEXICO REP.: JAY C. FAILING, ROOSEVELT BLDG., LOS ANGELES 14, CALIFORNIA
EXPORT MANAGER: GEO. P. GREGORY, JR., 30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK

Elect C. G. Cooper Vice President

Charles G. Cooper, manager of Cooper-Bessemer's Washington office, has been elected a vice president partially in recognition of his important role of directing Cooper-Bessemer's efforts in the defense program. Elected a director in 1945, Mr. Cooper has been responsible for the sales and servicing of government diesel and gas engine contracts, as well as all direct relations between Cooper-Bessemer and agencies of the U. S. government. He is the son of the late C. G. Cooper, formerly Cooper-Bessemer president, and grandson of Elias Cooper, one of the company founders.

John D. Gill Retires

John D. Gill, economist and director of The Atlantic Refining Co., retired on January 1 after being associated with the company since 1912. Mr. Gill's first position with Atlantic was as a lubrication research engineer in the laboratory department. In 1928, he was appointed to head the economics department. On May 5, 1931, he was elected to the board of directors of the company. A graduate of the University of Pennsylvania Mr. Gill served on the faculty of Pennsylvania Military College before joining Atlantic.

Malcolm D. Gilchrist

Named Procon Director

Malcolm D. Gilchrist has been elected a director of Procon Inc., a Chicago construction concern serving the petroleum and petro-chemical industry. The announcement of his election was made by John C. Raaen, president. Mr. Gilchrist is well known throughout the petroleum industry for his efforts in acquainting the industry with new refining processes. As well as being completely familiar with oil refining in this country, he also has acquired considerable experience in foreign refining operations as a result of having spent several years actively working with refiners in numerous foreign countries.

Cooper-Bessemer Increases San Francisco Staff

The Cooper-Bessemer Corp. has appointed Walter H. Kraemer to its field sales and service office in San Francisco, Calif. Mr. Kraemer has been associated with Cooper-Bessemer's recent development of new nodular iron, working directly under T. E. Eagan, chief metallurgist, and L. F. Williams, assistant to the president, who has been directing the program.

J. HOWARD MARSHALL has been elected vice chairman of the board of Ashland Refining Co., a new position. He will continue directly in charge of crude oil activities of the company but will be relieved of many former duties for which he was responsible as president. He has been succeeded as president by Rexford S. Blazer. Mr. Blazer formerly was president of two Ashland subsidiaries, Allied Oil Co., Cleveland, Ohio; and Frontier Oil Refining Co., Buffalo, N. Y. James L. Martin, a company director for more than 30 years was named chairman of the executive committee, a new post.

Willard Hassebroek

Hydrafrac Technical Supervisor

Creation of a new post, technical supervisor of Hydrafrac service operations, has been announced by Halliburton Oil Well Cementing Co. Named to fill the post is Willard Hassebroek, Halliburton development engineer. Currently, Halliburton has expanded its Hydrafrac Process operations throughout the United States; and is moving into foreign fields with the process.

Mr. Hassebroek's duties are the coordination of hydrafrac field services with research and development, disseminating operating and general information, and handling materials supply. He is attached to the staff of W. D. Owsley, Halliburton technical vice president.

R. L. AYCOCK, vice president of Pan-Am Southern Corp., has been placed in charge of supply and transportation. W. R. Remalia will be manager of supply, reporting to Mr. Aycock, and will coordinate refinery production and product purchase arrangements with branded and bulk sales requirements. John E. Monroe, general traffic manager, will be in charge of all distribution, terminals and product pipe line arrangements.

GEORGE W. CHAPMAN has been appointed as manager of the land department of Sun Oil Company's southwest division at Dallas, Texas. He succeeds Sam M. Gladney, who will devote full time to his post as assistant manager of the division.

DR. M. E. SPAGHT has been elected to the board of Shell Chemical Corp. Dr. Spaght is president of Shell Development Co. and brings to the board many years' executive experience in the field of petro-chemical research. He has been with Shell since 1933. On leave of absence at the conclusion of World War II, he served as member of the U. S. Naval Technical Mission to Europe and as director of the U. S. Strategic Bombing Survey in Japan.

Dr. M. E. Spaght

Tubular Sales Appointment

T. H. Creden, eastern district tubular products sales manager for A. O. Smith Corp., has been appointed assistant manager of the tubular division at Milwaukee. He will aid Dennis F. McCarthy, whose responsibilities have been expanded to include those of vice president and general manager of A. O. Smith Corp. of Texas, operators of a new pipe mill at Houston. J. J. Bohmann continues as coordinator of distribution and sales. Succeeding Mr. Creden in New York is Walter D. Wood, who moves from the post of Boston branch manager.

Heads Welding Equipment Sales

A. G. Hendrickson has joined A. O. Smith Corp. Jan. 1 as welding equipment sales manager. The company plans increased emphasis on marketing of welding equipment.

Joins W-K-M Co.

The W-K-M Co. of Houston, manufacturers of pipe line, Christmas tree and general duty valves, has appointed Harvey L. Hurley as assistant sales manager. Mr. Hurley comes to the company from the Rockwell Manufacturing Co.

George Basquez

George Basquez is New Emsco Ad Manager

Appointment of George Basquez as sales promotion and advertising manager is announced by Emsco Derrick & Equipment Co. He took over the post held by the veteran E. B. "Ernie" Fowks, when the company moved its advertising and sales promotion offices from Los Angeles to Houston.

Mr. Basquez has had a varied experience in drilling, production, manufacturing and sales, interrupted by four and one half years in the army during which he rose from private to captain. He was overseas 20 months with Gen. George Patton's 5th Armored Division and saw action in five major campaigns, including the Battle of the Bulge.

J. T. DURKEE has been appointed comptroller of General Petroleum Corp. A veteran of 31 years with General Petroleum he has been assistant comptroller and assistant treasurer since 1938. H. D. Osborn continues as assistant comptroller. Two new assistant comptrollers have been appointed, Gordon D. Campbell and Howard W. Wilson.

F. E. MELOTT, former area geologist and manager at Midland, Texas, for Deep Rock Oil Corp. has been transferred to be area geologist in a new office at Wichita Falls, while J. C. Meyer has been named area geologist, and H. W. Hitt, new area landman at Midland.

DON BILLS has been appointed acting district geologist in the Illinois Basin area for Cities Service Oil Co. (Del.), replacing Ralph Hamblin resigned. The Cities Service district geological and land offices for the area are located in Olney, Ill.

ARE YOU LOOKING FOR *Reefs*.

Bibliography of Organic Reefs, Bioherms, and Biostromes.

THE GEOLOGIST TAKES A NEW LOOK

The recent realization of the importance of organic reefs in the accumulation of petroleum has opened up broad, new vistas in the application of geology to the discovery of future oil reserves.

THE SEISMOLOGIST TAKES A NEW LOOK

The successful resolution of seismic data in possible reef areas involves, first, a thorough knowledge of the fundamentals of reef origin, occurrence, and characteristics.

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The LORAC Survey System for long distance, precision off-shore geophysical surveying is now available anywhere in the Gulf of Mexico.

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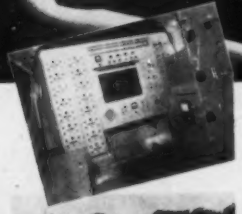
Seismograph Service

SSC Now oth

a Pilot Crew for preliminary surveys



The research division of SSC provides another "tool" for more accurate seismic exploration.

The new *laboratory on wheels* contains the equipment for a PILOT CREW to operate in new or extremely difficult shooting areas and in addition to conduct normal field tests. Its use will determine the proper instrumentation and field procedure to be used on an area by the regular seismic crew.

This unit should contribute to more accurate surveys as well as to effect economies in time and materials.

THE EQUIPMENT consists of —

1. Standard 24 trace recording unit.
2. 48 trace camera — permitting multiple recording.
3. Bank of 4 flat response amplifiers.
4. 4 trace variable area recording camera recording the output of the flat response amplifiers.

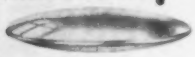
In general, the test shooting will be carried out on a 12-trace geophone spread, with the additional amplifiers paralleled to allow the recording of two filter settings and mixing on each shot.

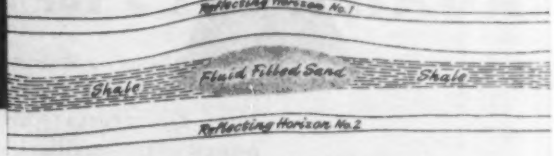
For laboratory study of the test shooting the records made with the variable area camera may be analyzed, when desired, with variable area reproducing equipment.

Seismograph Service Corporation

TULSA, OKLAHOMA, U. S. A.

This is IT !





a new method for the location of . . .

Sand Lens Type Oil Fields

Continuing research and development by SSC, to further utilize the possibilities inherent in the reflection seismic method to locate non-structural type oil fields, has resulted in a new approach to the location of stratigraphic traps.

This new seismic method, *another first* for SSC, for the location and delineation of *sand lens* type oil fields has been proved by 17 oil wells drilled to date by SSC clients.

Seismograph Service Corporation

TULSA, OKLAHOMA, U. S. A.

New Ansul Engineer

Fire protection engineer David C. Timberlake, formerly with Underwriters' Laboratories, has joined the engineering department, fire extinguisher division, Ansul Chemical Co. He will work on all phases of dry chemical fire protection, with special emphasis on design and installation of the company's new automatic piped systems.

Book Review

Reviews of Petroleum Technology, Vol. 9, covering 1947. Edited by F. H. Garner, O.B.E., E. B. Evans, and George Sel. Pp340. Published by the Institute of Petroleum, London, W.1, Price 27s 6d ($3.85).

This volume follows the general line of its annual predecessors and reviews the high-lights of petroleum technology during the year 1947. Its 25 chapters, each by an authority on the subject discussed, cover the range of petroleum industry from geology to legislation. In two instances—Refinery Plant and Engineering, and Plant Instrumentation—the articles cover progress in more than one year, 1940-7 in the former case and 1944-7 for the latter. Throughout the book there are references to over 2000 technical articles and patent specifications published during the year.

New Chemicals

The new product development department of American Cyanamid Co. has published "Collective Volume II," a compilation of data on several new chemicals which have become available from the company's research laboratories during the last year, and on which separate bulletins have been issued. Some of the chemicals covered are: Beta-substituted propionitriles, 3-substituted propylamines, Dipropionitriles, 2-nitrodiphenylamine, 2-amino-benzenethiol, Antioxidant 2246, Sodium Dicyanamide. Copies are available upon written request to the New Products Department, American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.

William Guier

Unit Rig Sold to Davis

Unit Rig and Equipment Co., Tulsa, one of the largest designers and manufacturers of oil field equipment and ditching machines in the country, has been sold to Ken W. Davis, Fort Worth, at a price indicated to be close to $2-million. In a joint announcement Mr. Davis and William Guier, president of the company, stated that the sale of the company to Davis does not involve any change in personnel or policy. Operations will be expanded.

Officers of the Unit Rig and Equipment Co. are William Guier, president; Ray E. Carter, executive vice president; J. H. (Jack) Smith, vice president and chief engineer, and F. C. Morton, secretary-treasurer. The company has branch offices and sales distributing centers in Dallas, Houston, Odessa, Snyder and Alice, Texas, and Casper, Wyoming. General offices are in the Kennedy Building, Tulsa.

Design Engineering Branch Formed

The Standard Oil Development Co. has formed a design engineering branch of its Esso engineering department. John W. Packie has been appointed head of the new branch as chief design engineer. George B. Cook will become chairman of the standards committee.

Other Esso engineering department appointments include advancement of Channing C. Nelson to supervising engineer, and Charles W. Smith, Raymond E. Bittner, and Benjamin L. Bragg to assistant supervising engineers. M. Ritchie Smith and Henry Ernst, Jr. become senior project engineers. George P. Baumann and Ashley R. Snyder were appointed group heads and Carl E. Kleiber became a design consultant on thermal and catalytic cracking problems.

Tank Cleaning Manual

A new edition of the American Petroleum Institute's manual on the cleaning of storage tanks which have contained gasoline has been published by the API's department of technical services. The new edition replaces the first one published in 1942. Title of the manual is "Cleaning Petroleum Storage Tanks; Section B—Gasoline Tanks." Section A, the companion piece, deals with the cleaning of storage tanks which have contained unfinished petroleum products. Copies of the new manual may be obtained from the American Petroleum Institute, 50 West 50th Street, N. Y. 20, N. Y., at 75 cents each.

New European Manager

W. A. Finn has been named general European manager of Worthington Pump and Machinery Corp., Harrison, N. J. with headquarters in Paris according to an announcement by S. R. Williams, vice president in charge of foreign business. He replaces A. W. Fraser, who is assuming an executive sales position with Worthington and will make his headquarters in Chicago.

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The first combination topping and decarbonizing unit and the first integrated Fluid catalytic cracker and cat poly unit were designed for this project.

At about the same time, Canadian Kellogg moved further west to design and construct a deasphalting unit for B-A's Clarkson Refinery.

And now, on the approaches to Canada's great, new western oil fields, Canadian Kellogg is constructing—at Edmonton, Alberta—a complete new refinery including Fluid catalytic cracking for this outstanding Canadian refiner.

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Portrait at

This year is Kellogg's fiftieth of service to industry. At this time naturally, as a group of men—known collectively to the modern business world as The M. W. Kellogg Company—we can think back nostalgically. We can remember the chimney stacks

"Ally of Process Development"

The first of these camera "portraits" of M. W. Kellogg today, which appeared last month in this publication, pointed up the completeness of the Kellogg organization working in the laboratory phases of applied chemical research and process development.

This month, some aspects of Kellogg's completely integrated Metallurgical Engineering Division are high-lighted to indicate the vital role they play in the advancement of processing, engineering and fabrication.

1. *PARALLELING KELLOGG'S* growth in the processing phase of oil refining has been its contribution to metal fabrication—a contribution based on early and continuing metallurgical research. As processing conditions have become continuously more severe and more exacting, this research has resulted in the creation of new, more precise specifications for materials . . . new methods of fabricating . . . and new methods of testing.

4. *PHOTOMICROGRAPHY, TOO,* plays an important part in Kellogg's metals research. It has proved particularly helpful to the company in its improvement of welding techniques both for shop and field fabrication. Demand for such metallurgical developments has so increased in the last decade that the original metallurgical laboratory has been expanded into a complete Metallurgical Engineering Division.

5. *X-RAY DIFFRACTION* serves continuously in Kellogg's investigation of metals for process applications—investigations conducted to develop metals for service at temperatures from about −300°F. to 5,000°F., and pressures up to 3000 pounds per square inch, and in the presence of such virulent corrosives as hydrofluoric and nitric acids.

Fifty... no 2

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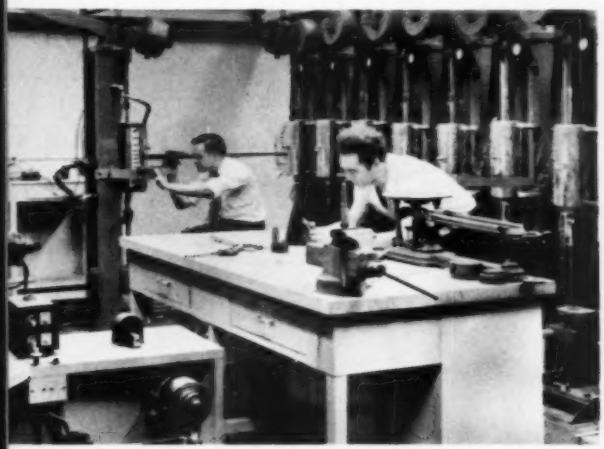
M KELLOGG W
1901-1951
50th Anniversary



2. *VESSELS, PIPING* and other metal equipment are, of course, the backbone of the refining industry. Moreover, high-temperature, high-pressure piping installations for utility power stations comprise the company's second largest sales operation. To meet the technical demands of this business, the characteristics of metals under a wide variety of conditions must be studied continuously, with modern test equipment.

3. *KELLOGG TODAY OPERATES* one of the most complete creep laboratories in the country, to study metals under all manner of temperature and load conditions. This biaxial test unit—believed to be the only one of its kind—exerts a two-directional stress at high temperature. In operation, tubular metal specimens are pulled apart at the same time as internal gas pressure seeks to burst them circumferentially.

6. *THIS INTERESTING TOOL*, termed a weld prober, was pioneered by the company's metallurgists for the study of *graphitization* in piping. This unusual metal "disease" was originally discovered in power piping operating under continuous high temperatures and pressures. The weld prober contributes significantly to the study, by permitting the removal of samples of welds and piping while the pipe remains in service position.

7. *MAGNETIC*, fluorescent dye and ultrasonic techniques—all non-destructive test methods—are also employed to explore the characteristics of metals before and after service under varying operating conditions. Guiding this continuing research into metal behaviour is a group of engineers and scientists who are internationally famous in their specialties, leaders on industry code committees, and members of key technical Defense groups.

NEXT MONTH

. . . in the third in this series of camera studies of M. W. Kellogg today . . . you will glimpse a few of the many development projects which utilize the results of these metallurgical studies.

M.W. KELLOGG

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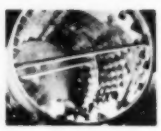

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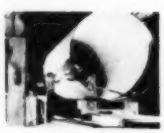

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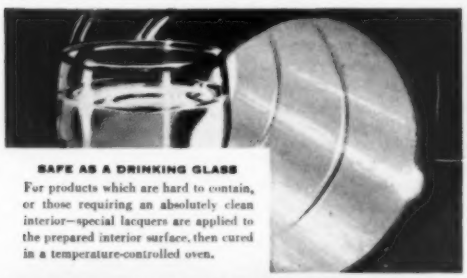

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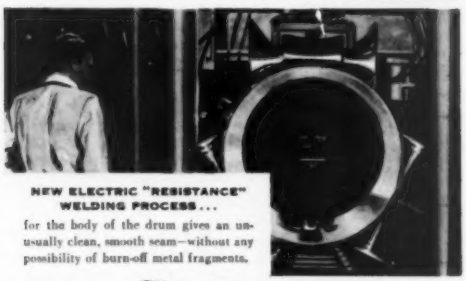

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German Crude Production Exceeds Million Tons

By A. M. Stahmer

PRELIMINARY reports from the German oil fields show a total output of 1,118,400 tons crude during the past year, a daily average of 23,400 barrels. This result surpasses the former peak yield of the year 1940 (1,056,187 tons) which had been achieved by forced production methods. Last year's output is more than double that of 1945, the year of the capitulation, and represents an advance of nearly 33 percent over 1949.

The favorable development of the German crude producing industry is due to two factors: systematic exploration of fields discovered during or shortly before the war, and intensive wildcatting which added new finds to the known fields.

One important discovery already has been made in 1951 with the bringing in of Hohne 1 of Deutsche Erdoel-AG, twelve miles east of the town of Celle. First results indicate that this is a valuable new find for Western Germany. The crude is light and contains a large proportion of gasoline. It comes from a depth of 5,761 to 5,784 feet from a sandstone of the Lias Alpha which has not yet been fully penetrated. Production tests gave an initial flow of approximately 350 barrels daily.

The well, which is situated near the village of Hohne, was located on the strength of reflection seismic surveys on a deep intermediate structure of the same type as those of the new Suderbruch and Eldingen fields.

With a share of 45.1 percent in the German total the Emsland oil district in 1950 for the first time took the lead, followed by the Hanoverian oil province (44.4 percent). Schleswig-Holstein contributed ten percent and Baden the remaining 0.5 percent.

While there were important discoveries in 1949 and 1950, the reserves of which are estimated at 15 million tons, the greater part of the advance in German crude production is a result of development of deposits found in the late thirties or early forties. This once more proves the old rule that it generally takes years of drilling work to develop a deposit to the height of productivity. Out of the approximately 277,000 tons, by which 1950 production rose over that of 1949, as much as 92,000 tons are from Georgsdorf in the Emsland which in 1950 accounted for about 20 percent of the German total. Emlichheim yielded 25,000 tons more than in 1949. In both these fields the rise would have been still greater had not the operators decided to reduce yields in order to maintain reservoir pressure. In the field Lingen-Dalum, which has been successfully extended, the output went up by about 14,500 tons. An increase of 17,000 tons each over last year's figure has been reported from the Hanoverian fields, Steimbke and Wesendorf; in the field Heide (Holstein) production rose by 11,500 tons. Minor pools such as Fuhrberg-Hambuehren, Reitbrook, Wietze, Etzel and Oberg also increased their yields and thus made up for the slow natural decrease in other fields like Nienhagen, Thoeren, Haenigsen, Hademstorf, Moelme and Adorf.

In 1950, the fields discovered during the past two years in the Emsland and the Hanover district produced a total of 105,500 tons, approximately 100,000 tons more than in 1949. First among them was Suderbruch with 33,878 tons, almost equaled by Ruehlermoor with 30,764 tons. The field Quakenbrueck where, owing to the high cold test of the crude, production can only be carried on with heated tubings, gave 13,014 tons, Ruehlertwist 10,685 tons, Scheerhorn 9,593 tons and Eldingen 6,736 tons. Minor contributions include Wathlingen, 76 tons from Hohenhorn and 28 tons from Eddesse-Nord.

To complete the picture of the performance of the German crude producing industry during 1950 it must be mentioned that during the past year millions of marks were spent on wells which turned out to be dry. Drilling amounted to approximately 400,000 metres, about 100,000 metres more than in 1949, but the extent of new deposits was less than in that particularly good year. New finds were those at Quakenbrueck, Wathlingen and Eddesse-Nord, as well as holes near Diepholz (St. Huelfe and Rheden) where, however, it is doubtful whether production can be taken up on account of the very high cold test of the crude. Exploration in southern Wuerttemberg has given encouragement to further prospecting. Production may also be expected in Schleswig-Holstein from deep drilling done in 1950. On the other hand more than 100 deep wells in various parts of northern Germany and in the South had to be abandoned without positive results.

Out of the total German production of 1,118,400 tons, 63.8 percent is accounted for by German private companies (Wintershall AG, Gewerkschaft Elwerath, Deutsche Erdoel-AG, C. Deilmann, Bergbau GmbH, Itag and others), 21.3 percent by foreign private firms (Deutsche Vacuum Oel AG, Gewerkschaft Brigitta) and 14.9 percent by state-owned German companies (Preussag, Deutsche Schachtbau-und Tiefbohr GmbH, Braunschweigische Bohrges.mbH).

German Crude Production In Tons

	1949	1950[1]	December 1950[1]
Emsland	324,940	504,560	46,753
Hanover	412,712	496,306	45,553
Schleswig-Holstein-Hamburg	98,024	111,598	10,034
Northwest Germany	835,676	1,112,464	102,340
Baden	5,900	5,941	510
Total Germany	841,576	1,118,405	102,850

[1] Preliminary figures

Houdriflow Unit Completed

Salt Lake Refining Co. has completed a 13,000-barrel Houdriflow catalytic cracking unit. This is the largest unit of this process to go on stream thus far according to General D. N. Hauseman, Houdry Process Corp. president. The unit circulates 300 tons per hour of pelleted catalyst with a gas lift.

The new design removes catalyst flow limitations inherent in mechanical lift units thus increasing flexibility and permitting liquid feed.

The kiln is simplified with the reactor and kiln superimposed so that catalyst is lifted only once.

New Oil Well Pumping Control

A new oil well pumping control, that features new design in the magnetic starter, overload relay, motor disconnect switch and lightning arrester, has been announced by the control divisions of General Electric. A new starting timer provides increased flexibility for starting motors after shutdown. An improved time switch with new camriders for more reliable time settings has also been developed for the control. By far the outstanding feature of the new pumping control is its ability to withstand voltage surges caused by lightning.

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Discovery Rate Well Maintained

(Continued from page 38)

toward the end of 1950 the domestic supply of liquid petroleum was less than a third of the national demand.

The Republic of Mexico also was making remarkable progress in building up its crude production in 1950 through an active drilling campaign. Production increased 18 percent to 197,500 barrels daily giving Pemex a comfortable surplus of oil for export.

More than half of Mexico's current production is from the Poza Rica field, a condition which Petroleos Mexicanos considers unsatisfactory. It is therefore carrying on an active wildcatting campaign while continuing to develop its currently known reserves. Wildcat operations of Mexican American Independent on the Isthmus of Tehuantepec have not been very rewarding as yet. Five wells were drilled in 1950 of which two were gassers, one a 150-barrel pumper, one was dry and another is being worked out.

Considering North America as a unit, crude production in 1950 rose 7.5 percent to 5,662,500 barrels daily representing 54.6 percent of the world supply. South American production rose 11.7 percent to 1,758,700 barrels daily representing 16.9 percent of the world supply. Greater production from Middle Eastern fields caused the Eastern Hemisphere to become about self-sufficient with 28.5 percent of the world's oil supply and 40 percent of known reserves.

For 1951 it is apparent that the oil industry can supply the world's demands for petroleum and make reasonable additions to known reserves on the basis of currently projected drilling programs.

Key Licenses Lake and Elliott

Key Co., East St. Louis, Ill., has licensed Lake and Elliott, Ltd., Braintree, England, to manufacture return bend fittings in Sterling territory. In the photograph G. C. Smith, export manager of Key Co., and R. J. Hart, chief inspector of Lake and Elliott, Ltd., are examining a prototype header and rediograph in the laboratory of the Lake and Elliott foundry at Braintree.

Black Capacity Increased

J. M. Huber Corp. is doubling the size and capacity of the new furnace carbon black plant which it has under construction near Baytown, Texas, on the Gulf Coast. Originally planned last July to produce 36,000,000 pounds annually of HAF type carbon black, the revised construction estimates call for an annual capacity of 72,000,000 pounds. The first unit will be ready for production on May 15 and the second on Nov. 1.

PAD Receives Full Authority

(Continued from page 39)

Justin R. Wolf, assistant deputy administrator of PAD and general counsel. He has been a Washington lawyer.

Richard G. Lawton, director of PAD's production division, president Lawton Oil Co., Magnolia, Ark.

Frank Watts, director PAD's materials division, general sales manager for Humble Oil and Refining Co., Houston.

Reid Brazell, director of PAD's refining division, president of Leonard Refineries, Alma, Mich.

Cecil L. Burrill, director of PAD's program division, former director of Creole Petroleum Co., subsidiary of Standard Oil Co. (NJ).

Dene B. Hodges, director of PAD's transportation and supply division; comes from Shell Oil Co.

Elmer E. Batzell, finance counselor, who has been a Washington lawyer. George Gibson, Bechtel Corp., assistant counselor.

Bryant Putney, information officer; has been on Secretary Chapman's staff.

Joseph V. MacHugh, assistant to the deputy administrator on Congressional liaison.

Thomas L. Apjohn and Donald P. Heath, both of Socony-Vacuum Oil Co., are PAD's aviation gasoline experts.

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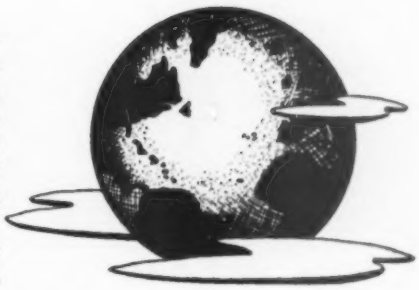

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Nomads Elect Officers

Howard Book of Reed Roller Bit Co. was elected president of the New York Nomads at the recent annual election. The group of newly elected officers is pictured above. Seated: left to right, Fred J. Jobst, secretary; Mr. Book; and Al. Dill, vice president. Standing: Henry J. McAdams, retiring president who was elected regent; John D. Evans, treasurer; R. E. Elmore, assistant sergeant at arms; George I. Lynch, assistant treasurer; Russ V. McIntyre, sergeant at arms; and Kenneth D. Demarest, regent. First meeting under leadership of the new officers was held at Sherry's on Feb. 5.

At their annual meeting on January 19, the Nomads of Los Angeles chapter elected officers for the current year. Shown above are: (left to right) seated—John H. Flanagan, treasurer; Lee J. Laird, regent; J. A. Engstrand, president; Earle M. Boggess, regent: (standing) Vernon A. Mitchell, assistant-treasurer; George W. Gutekunst, assistant secretary; John W. Rife, executive secretary; James D. Hughes, sergeant-at-arms. Not present when the photograph was made were Earl M. Rees, vice president; W. A. Wilson, secretary, and W. H. Sargeant, assistant sergeant-at-arms.

Amos A. Roberts was inducted as president of the Tulsa chapter of Nomads at the January meeting which was attended by more than 200. Program for the meeting included an address on current government and business trends by Alfred P. Haake of General Motors Corp. Nomads officers for the new year, seated, left to right, Arch F. Campbell, sergeant-at-arms; Amos A. Roberts, president; Dr. Haake, speaker of the evening; G. L. Coons, secretary; Gilbert Swift, treasurer; R. E. Kirberger, assistant secretary. Standing, left to right, R. C. Glover, deputy sergeant-at-arms; Opie Dimmick, regent; J. S. George, assistant treasurer; G. W. Davidson, Jr., regent; H. M. Cooley, vice president.

Jack Barnes was master of ceremonies at the annual dinner dance of the Houston chapter of Nomads at which Wayne Rives was inducted as chapter president. Pictured at left are 1951 chapter officers. Front row: left to right, E. F. Baldwin, secretary-treasurer; Wayne Rives, president; E. H. Lorehn, regent; and Jay Speece, deputy sergeant-at-arms. Back row, left to right, Tracy Wood, Jr., regent; Herschel Wood, vice president; Larry Kelley, assistant secretary-treasurer, Bob Franklin, sergeant-at-arms; and Harry Estes, executive secretary.

Walter B. Pyron

Brigadier General Walter B. Pyron, United States Army, retired, and a former vice president of the Gulf Oil Corp., died suddenly at his San Antonio, Texas home January 8. General Pyron retired from Gulf last spring following 43 years service with that company. For five and one-half years prior to his retirement General Pyron had maintained his headquarters in London where he was in charge of production operations of Gulf subsidiaries in Europe and the Near East.

During World War II, General Pyron formulated plans for the construction of aviation gasoline plants and was later named chairman of the War Department Committee on Liquid Fuels and Lubricants and supervised the revision of specifications for military fuels and lubricants.

He organized the Army-Navy Petroleum Board to coordinate, procure, and transport all bulk petroleum products to be used by the Allied Nations. On release from active duty with the U. S. Army in October, 1945, he was honored by the award of the Legion of Merit, and received the personal commendation of the Undersecretary of War.

To Enlarge Neodesha Refinery

Standard Oil Co. (Ind.) will increase the crude capacity of its Neodesha, Kan., refinery by 9,300 barrels per day. The plant currently processes 10,400 barrels of crude oil per day. Existing crude oil distillation, coking, and re-running units will be revamped. In addition, new tankage and utilities equipment will be installed together with new facilities for improvement of product quality.

Surplus cracking stock will be moved from Neodesha to Standard's refinery at Sugar Creek, Mo., for processing. Later a catalytic cracking unit may be built. Certain other unfinished and finished products will also be moved to Sugar Creek for distribution. First phase of the Neodesha expansion program is expected to be completed early in 1952.

Book On Safety

Safety in Petroleum Refining and Related Industries. Compiled by George Armistead Jr.; published 1950 by John C. Simonds & Co. Inc., New York 7, N. Y.; 416 pages, $10.00. May be ordered through World Petroleum Book Department.

From its nature the petroleum refining industry has plenty of reason for acting on the principle of "safety first". In following out that policy, there is large need for widespread information on the causes of accidents. The compiler has undertaken what is evidently a noteworthy project in collecting and disseminating this information. He considers many cases and classifies them in five principal groups: misoperation or improper practices; equipment failure; attempting to repair equipment while operating; lightning, windstorm and other elemental disturbances; improper equipment and miscellaneous causes.

The main emphasis is on prevention: accidents should not happen. A valuable feature of the book is an appendix giving the properties of flammable substances, hazardous chemicals, corrosion resistance of metals, insulation and other equally important topics.

Continuous Tel Process

A new continuous process for the manufacture of tetraethyl lead has been perfected by DuPont and construction will start immediately at Deepwater Point, N. J., on the first new continuous production unit which will have an annual production capacity of about 50 million pounds of tetraethyl lead a year. Completion is scheduled for January 1952.

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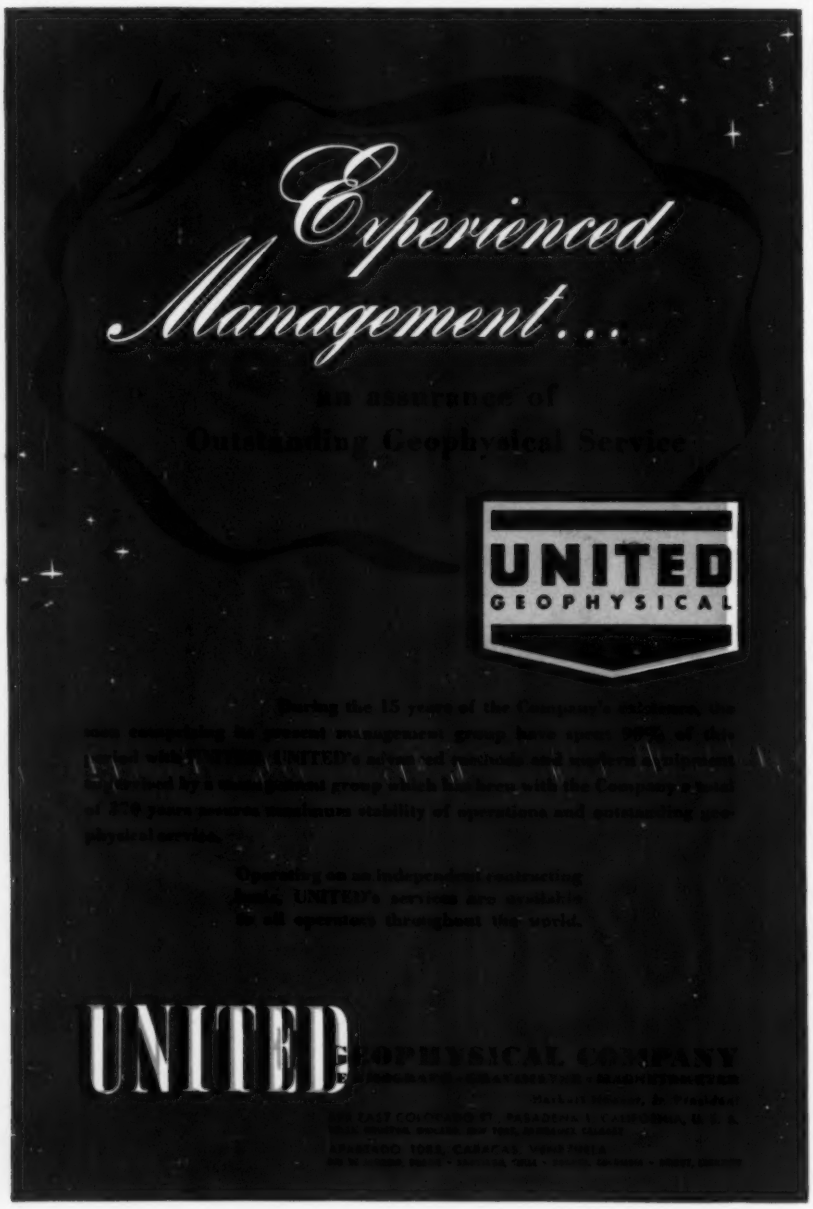
World Geography of Petroleum

A noteworthy addition to the ever growing literature of oil is the World Geography of Petroleum published for the American Geographical Society by the Princeton University Press. The work is edited by Wallace E. Pratt, dean of American geologists and former vice president of Standard Oil Co. (N.J.), and Dorothy Good, in charge of special publications for the American Geographical Society. The list of contributions contains the names of outstanding authorities and the chapters dealing with various producing areas have been written by men whose knowledge is based on practical experience in the field described.

As Mr. Pratt points out in a foreword to the volume the fields of geology and geography overlap and geology may claim for its own the past operation of earth processes which concern geographers mainly in their present manifestations. But geography touches the petroleum industry over another wide area into which geology does not extend. In its broad aspect the discovery and distribution of petroleum resources are live problems of human geography profoundly influencing human relationships over the whole globe.

It is from this broad angle that the petroleum resources of the countries and areal divisions of the earth are discussed in this volume. The authors relate briefly the history of each area, describe the fields included within it, show the stage of their development and the facilities for processing and transportation. Beyond these topics however they deal with operating conditions, the laws and regulations affecting the industry, its economic influence and the place it occupies in the general world picture. Statistics receive due attention and there is an admirable statistical survey directing the reader to sources from which current information on this subject may be obtained.

The volume is enriched with a wealth of illustrations showing the many phases of industry operations and the equipment employed. Maps of important fields aid a ready understanding of the accompanying text and others show transportation routes, tanker lanes and bunkering stations. The work as a whole is not only a useful reference book for those directly engaged in the oil industry but also provides an entertaining and instructive survey of the world's petroleum resources and their important contribution to human progress for the non-technical reader. **World Geography of Petroleum, 464 pp. plus illustrations. Edited by Wallace E. Pratt and Dorothy Good. Published 1950 for the American Geographical Society by Princeton University Press, Princeton, New Jersey, U.S.A. price $7.50.**



The above illustration of structural work on the new vacuum distillation unit of the Llandarcy refinery of Anglo-Iranian Oil Co. is from a photograph taken in December 1950. It shows construction proceeding under wintry conditions unusual in Britain.

Oil Stockpiling Urged for Defense

Controversial discussion has developed in Washington over a report prepared by Halford L. Hoskins of the Library of Congress and issued by the Library which deals with the question of oil supplies for the United States in time of war. Adopting an assumption often expressed but by no means accepted by military authorities or by members of the international oil industry that in case of attack by the Soviet Union the oil fields of the Middle East would quickly be put out of operation or fall into enemy hands and that other shipments from overseas, as for instance from Latin America, might be prevented by submarine attack from reaching this country in the event of war, the author asserts that the only effective method of avoiding shortage is by stockpiling.

If dependence for wartime needs is to be placed on domestic supplies, says the report, the only way to accomplish this is to develop fields ready for prompt use in time of emergency but to keep them shut in and to satisfy current requirements by imports, probably from the Middle East.

"This," Mr. Hoskins observes, "means the substitution of government for private control and the investment of public funds on a considerable scale in properties and facilities that would bring a return only in time of national distress. . . . The corollary of this line of action obviously lies in replacing the oil thus impounded. Under existing conditions this would involve no price differential and for a good many years to come there need be no diminution of supply."

The author foresaw clearly that his report would stir up strong opposition, particularly from those oil producers who have consistently fought all imports. In this respect he has not been disappointed. Protests have been loud and long and the general opinion is that no such proposal has a ghost of a chance of adoption. Stockpiling, however, is a project favored by many military authorities and in some modified form it may still be adopted.

New A.P.I. Research Project

A study of marine sediments to determine how petroleum deposits are developed has been approved by the American Petroleum Institute research committee. Annual cost of the study will be $123,000 for at least three years. Scripps Institution of Oceanography, La Jolla, Calif., will do the field work.

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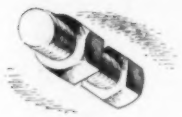

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Somebody keeps a check on coal supplies and water; on electricity and gas. Somebody looks after the nuts and bolts and things in the stores. But who "storekeeps" the steam?

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DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

March ★ One of a Series of Interest to the Petroleum Industry ★ 1951

Additional Facilities For Petroleum Laboratory Nearing Completion

The Du Pont Petroleum Laboratory, devoted to fundamental research and technical development on chemical additives for fuels and lubricants, will soon increase its laboratory facilities by approximately 50%. Work on the expanded facilities started about a year and a half ago. Some units are now in operation and it is expected all will be functioning by late spring.

The expansion, located principally in a new building, will add considerably to the laboratory floor space and will permit greatly increased activity in the petroleum chemicals research program which originated about three years ago.

Tel Tank Car Unloading Simplified by Du Pont-Designed Metal-Flex Hose Line

Conventional pipe lines with swing joints for loading and unloading TEL tank cars have never been completely satisfactory. Keeping the joints properly packed so as to prevent the escape of dangerous tetraethyl lead or "lead" fumes always presented a safety and maintenance problem. Repacking such joints frequently tied up three or four pipefitters for an entire day.

Even when properly maintained, there was no assurance that joints would be tight and unloading difficulties were often encountered due to leaks. Swing joints that did not leak were usually so tightly fitted that the operators had difficulty in manipulating them into position. This cost both time and effort.

Du Pont recognized the cost and hazards associated with the maintenance of such lines and designed a metal-flex hose which eliminates swing joints altogether.

Complete flexibility of this hose is obtained through the use of a flexible metal tube which is strengthened by braided wire mesh to withstand pressures up to 100 lbs. per sq. in.

Customers report the following advantages:

1. Greater ease in connecting up the tank car. Only one man required where, with the old style, two men were frequently needed.
2. Freedom from leaks which cause unloading difficulties.
3. Complete elimination of expense and hazards connected with repacking the old type swing joint.

Du Pont standard drawings and specifications now include the flexible type hose as standard equipment. The operation of replacing the old type line and swing joints with metal-flex hose is simple and inexpensive. The Company can make the hose available through its Petroleum Chemicals Division District Offices and is happy to furnish the necessary engineering service.

Success of National Tour of Du Pont Road Octane Fuel Test Fleet in 1950 Leads to Expansion of Activity for '51

Back in May 1950, Du Pont began a new kind of experiment. It originated around three highly instrumented automobiles. These were designed to show that road octane tests could be conducted with a neatness and dispatch hitherto not often practiced in the petroleum field.

Test cars Nos. 29, 30 and 31 shined up for the 1950 cross-country tour. Du Pont men in the foreground are Harold Russell, Carl Ferris and Ray Spender discussing the route to be taken to the next day's demonstration.

In the course of a few months the cars toured the country from coast to coast giving test demonstrations to refinery personnel everywhere. At the end of their trek each of the cars, an Oldsmobile, a Plymouth and a Chevrolet, had covered some 23,000 miles.

Out of 236 petroleum company headquarters and division offices contacted before and during the tour, 233 indicated an interest in the project and requested that presentations or demonstrations be made to their personnel. The showings varied from private viewings of the cars in big-city hotels including formal talks or round-table discussions, to road demonstrations at refineries situated many miles away from the nearest town.

There was nothing new in the actual instrumentation of the demonstration cars. But the convenient way Du Pont engineers arranged it on the dashboard, and especially the ease achieved in changing from one fuel to another by the simple manipulation of push buttons, showed that road octane testing did not necessarily have to be the somewhat crudely conducted chore so many had thought it to be.

And that is what appealed especially to most of the 3,144 petroleum men who saw these cars in 1950. It is also the reason for the augmented fleet planned in 1951.

OVER

ADVERTISEMENT — Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

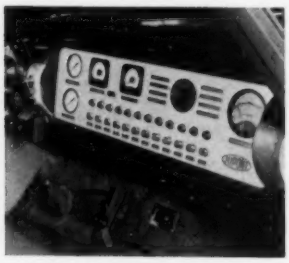
CONTINUED

Fleet Tour

The three original cross-country cars have been torn down, examined, checked, reassembled and restored to perfect running order. Two were subsequently sent to Florida on a brief tour along the Plantation Pipe-line. The third was driven to the Chicago territory where it is being used by various petroleum companies as an aid in dealer training.

Soon four more cars will be added to the fleet. These will be the latest models of Packard, Buick, Ford and another Oldsmobile. They will be instrumented in much the same way as the three original cars.

But the seven road test cars, this time, will not go on tour. Instead one, or two, will be assigned to each of the five Du Pont Petroleum Chemicals District Offices where they will be made available to refiners, laboratories or marketing groups for educational or demonstration purposes.



The instrument panel of the test cars is designed to blend with the original dashboard. The push buttons for venting, for tank fuel, and for reference and test fuels are in line on the lower part of the panel. Red warning lights indicate the fuel being used.

For those organizations who desire to build similarly instrumented road octane test cars of their own the Du Pont Company will be happy to supply specifications and photographs. The Company will also give, wherever possible, such personal technical assistance as may be needed to place the cars in operation.

With the advent of the new cars, Nos. 39 to 42, this will bring to forty-two the number of cars and trucks that have operated in the Du Pont Petroleum Chemicals Division test fleets. Of this number twenty-eight are in active operation today.

Aviation Specialist on Staff of Petroleum Chemicals Division

JOHN R. GRIFFIN, JR. joined the technical staff of the Du Pont Petroleum Chemicals Division in July 1950, and now specializes in fuel and lubrication problems connected with aviation. He holds a Master's degree in engineering.

After a year of teaching at the University of Texas, he joined the Lockheed Aircraft Company where he engaged in the structural testing of planes including many of the tests which prepared the now famous P-38 for flight. In 1941 he joined the Shell Development Company to work on lube oil development for 2½ years. From 1943 to 1949 he was with Trans World Airlines handling maintenance problems. During his last four years with TWA he was in charge of engineering for over-ocean operations at New Castle Airport, Delaware. He came to Du Pont from the Sharples Corporation where he was chief engineer in the research laboratory.

At present, Griffin spends most of his time conferring with airlines regarding present and future developments of the various types of aircraft propulsion units and fuel requirements for these units.

Du Pont Spray Glaze

New Car Polishing Product Saves Time and Labor

Attractive new SPRAY GLAZE container belongs to famous Du Pont No. 7 Line of products.

SPRAY GLAZE, a new protective coating and polish for automobile finishes was brought out by Du Pont in 1950. Formulated to be applied with a special spray gun, Du Pont SPRAY GLAZE is for use by service stations, car dealers, body shops and fleets. It produces a higher lustre than waxes and requires less time and labor to apply.

After the car finish has been thoroughly cleaned, SPRAY GLAZE is applied by air gun over the entire surface in a matter of a few minutes. Final polishing is easily and quickly done by hand with clean dry cloths. Because of the nature of SPRAY GLAZE, hard rubbing is not necessary.

LITERATURE AVAILABLE

The Petroleum Chemicals Division of Du Pont has published a wide variety of material of interest to the petroleum industry. This includes technical papers, bulletins, reports and memoranda as well as equipment operation bulletins, safety regulations, tank cleaning data, marketing aids and the like.

Any of this is available on request to your nearest Du Pont Petroleum Chemicals Division District Office. A partial listing of available material is shown below:

Tank Talk—A new 52-page booklet designed for easy reading by tank cleaning personnel . . . . . Serial A-1134

Blending calculator for Du Pont TEL Compound (Aviation Mix) . . . . . Serial A-1210

Exhaust Valve Rotation—A resume covering the use of mechanical devices to improve valve life . . . . . Serial A-656

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Geophysical Brochure

Copies of a 20-page brochure on the activities of Southern Geophysical Co. relating the five years of growth of this company are now being distributed to the oil industry, Dr. Sidon Harris, president of Southern, has announced. Contents include photographs of the Fort Worth and Midland offices of the company, key personnel, field and laboratory pictures, numerous seismic records, experience maps and charts showing the growth of the company which has a record of 99.12 capacity of operations during the past five years.

In a preface Dr. Harris makes this comment, "Since the first shot was fired by Party No. 1 in June 1945, Southern has grown to 13 well-equipped and expertly staffed seismograph field parties. This growth was made possible by the confidence of our clients and the ability to submit careful and accurate interpretations which have resulted in locating more than 20 commercial oil fields including several difficult reef discoveries."

Copies of the brochure may be obtained by request to Southern Geophysical Company, 600 Bailey Avenue, Fort Worth, Texas.

Capt. Archibald MacDougall

Senior Master Retires

Capt. Archibald MacDougall has retired after more than 30 years' service with the Shell tanker fleet. He joined The Anglo-Saxon Petroleum Co. as a third officer in March 1920, and from that date served in no fewer than 29 tankers. In 1930 he was promoted Permanent Master and in 1947 Senior Master—one of only six in the world-wide Shell fleet to hold the highest rank. None of the 17 ships that he commanded throughout the arduous and dangerous war years, suffered any kind of mishap, except the "Horn Shell" which was hit by four torpedoes in mid-Atlantic on July 26, 1941, while sailing in ballast from Gibraltar to Trinidad. It was not until Aug. 8 that Capt. MacDougall's lifeboat was sighted by a Brazilian ship and the occupants landed at Pernambuco. In recognition of his valiant endeavors to save "Horn Shell" the owners of the tanker made a special presentation to Capt. MacDougall.

New Developments in Alkylation

New developments in alkylation, basic process in the production of high octane aviation fuel, are discussed in the most recent issue of the Kelloggram published by The M. W. Kellogg Co. The booklet also discussed the use of alkylation as a method of raising octanes to meet the challenge of the high compression automobile engine, a field in which this process has very promising possibilities, according to Kellogg.

In addition to reviewing the process and its developments since the end of World War II, the Kelloggram tells briefly the story of two new alkylation units, built before the present emergency and aimed, in their original intent, solely toward producing a high octane blending component for automotive gasoline.

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New Type Hydraulic Jar

A new type jar has been developed by M. O. Johnston Oil Field Service Corp. The Johnston-Sutliff jar is operated hydraulically so that mechanical tripping is eliminated. Result is that the jar will deliver a continuous series of blows over any necessary period of time with only a simple manipulation at the well head.

Lubricating oil is used as the hydraulic fluid, the entire space between mandrel and outer housing being filled with the oil. Oil can be checked and added without disassembly. When replacement is necessary the jar need be broken in only three joints.

No rotation is necessary to operate the jar, but provision is made for use of rotation which may be required by other tools in the string. The mandrel is keyed to the outer housing to prevent its rotation and to allow backing off to right or left below the jar.

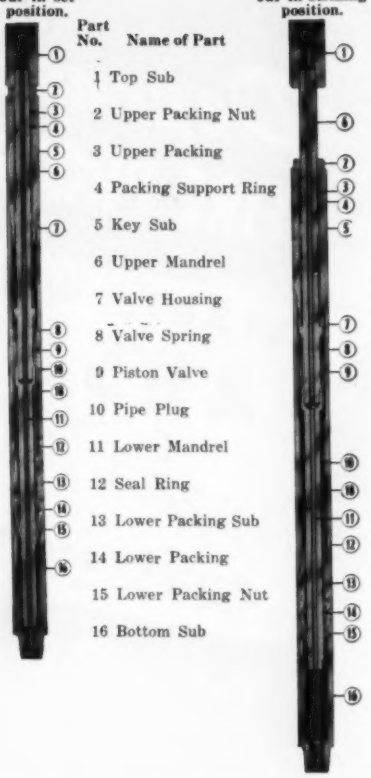
Maximum outside diameter of the tool does not exceed that of full-hole tool joints. Sizes range from 3⅜ to 6¾ inches OD. The jar is stronger than any part of the string in which it is run. It may be employed with either light tubing or heavy drill pipe at any length. Due to the simple method of regulating intensity of blow the limitations of equipment being used need not be exceeded. Intensity of blow is regulated by raising pipe until the desired weight is shown on the weight indicator.

Operation of the Johnston-Sutliff hydraulic jar will be understood readily by reference to the illustration which shows the jar in both set and striking positions.

When the string is raised, a tension approximately equal to the amount shown on the weight indicator is placed on the mandrel and causes it to rise. As the piston, which is an integral part of the upper mandrel, is pulled up through the restricted area in the valve housing, pressure on the oil above the piston is increased. This forces oil down through the clearance between the piston valve and the restricted area of the valve housing and into the annular space below. The pressure is maintained in balance by the hydrostatic pressure of the well fluid.

Fig. 1
Jar in set position.

Fig. 2
Jar in striking position.



Part No.	Name of Part
1	Top Sub
2	Upper Packing Nut
3	Upper Packing
4	Packing Support Ring
5	Key Sub
6	Upper Mandrel
7	Valve Housing
8	Valve Spring
9	Piston Valve
10	Pipe Plug
11	Lower Mandrel
12	Seal Ring
13	Lower Packing Sub
14	Lower Packing
15	Lower Packing Nut
16	Bottom Sub

Because the clearance is so small, the piston moves slowly until the bottom of the piston valve reaches the enlarged area of the housing. At the instant it reaches this point, the piston is free to move without restriction and is suddenly jerked upward by the tension in the string, causing the hammer to strike the anvil, as shown in Figure 2.

When the string is lowered, the piston valve opens and allows the oil below the piston to flow freely through the by-pass channels into the annular space above, permitting the jar to return unrestricted to "set position" (Figure 1).

The jarring cycle requires only the time necessary to raise the string, a momentary pause while the piston moves to its free striking position, and the lowering of the string to return the piston valve to "set position." The next blow can be delivered immediately and continuous jarring can be carried on for any length of time necessary.

A bulletin dealing with the jar has been published by M. O. Johnston Oil Field Service Corp., 3035 Andrita Street, Los Angeles, 65.

Buys Half Interest in Well Surveys

Lane-Wells Co. has purchased 50 percent of the capital stock of Well Surveys, Inc., Tulsa. The remaining half of Well Surveys' stock is owned by Socony-Vacuum Oil Co., Inc. Well Surveys was formed in 1939 to engage in the development and exploration of radioactivity well logging techniques and equipment. Lane-Wells has been the principal licensee under Well Surveys patent and has performed over 30,000 well logging operations since this service was introduced in 1940.

Rodney S. Durkee, president, and Dr. Russell M. Otis, manager of research and patent department, of Lane-Wells have been elected directors of Well Surveys. The other members of the board are: Willis W. Hardy, of Socony-Vacuum; Henry Cortes, of Magnolia Petroleum Co.; and W. G. Green, president of Well Surveys. Officers of Well Surveys, Inc., are W. G. Green, president; Charles E. Duller, vice president and treasurer; Robert K. Schumacher, secretary; and E. B. Clemens, assistant secretary.

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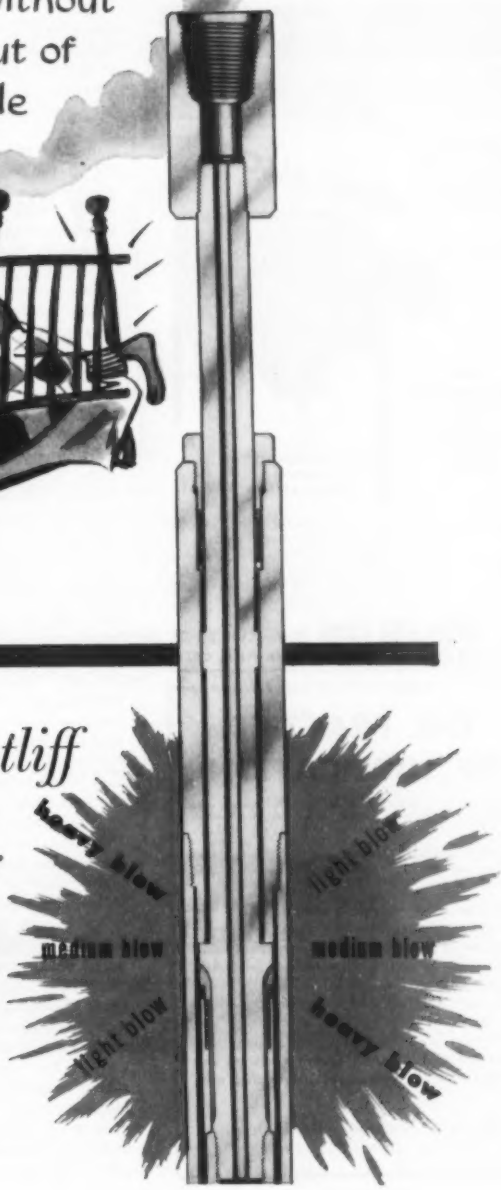

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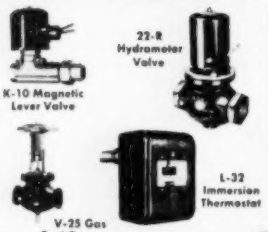

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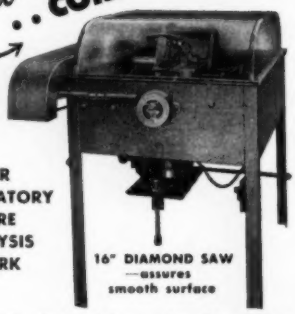

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Tax Policy and Petroleum Supply

(Continued from page 49)

ground. In Texas, for example, a number of sales of properties have been made in recent years at a price of about $1.00 a barrel for proved, developed reserves. Deducting from this price a typical development cost of 30-35 cents a barrel (which is in addition to all the exploration expense), indicates a discovery value of about 65-70 cents.

Depletion at the rate of 27.5 per cent has operated similarly to reflect the capital value of oil reserves in the ground over the full range of prices experienced since 1926, when the average price was $1.88 a barrel and the provision meant a maximum allowance of 51.7 cents on that price. In the years 1930-1940, for example, the price of crude oil averaged only about $1.00 a barrel, on which the maximum depletion allowance was 27.5 cents. That amount was in line with the capital value of oil in the ground at that time. Similarly, in the post-war period percentage depletion continued to reflect the changing capital value of oil in the ground as increased costs in the search for oil and inflation generally brought about rising prices. Such relations demonstrate that the depletion provision is still operating as intended in permitting the recovery of capital value, and that there is no justification for reducing the rate.

The current rate of percentage depletion also appears reasonable in relation to industry experience. Cost estimates based on the total drilling and exploration activities of the industry indicate that in 1949 the oil industry spent more than a billion dollars on exploration alone, in addition to another billion dollars on drilling and equipping productive wells. In spite of the high rate of operations in 1949, exploration expenditures for the industry apparently were fairly close to the total depletion allowed under the present rates.

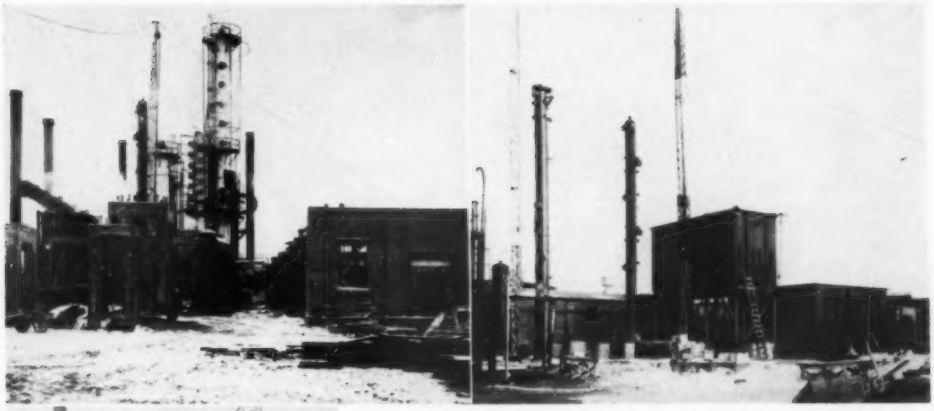
Another test of whether the prevailing percentage depletion provision has been too liberal is the rate of profit. If the tax provisions applicable to the depletion of oil production have been too liberal it should show up in a rate of profit higher for the oil industry than for other industries and should result in attracting into oil production more capital than necessary. Actually, available statistics show that the rate of earnings of corporations in the petroleum industry has averaged less than that of corporations engaged in manufacturing and trade.

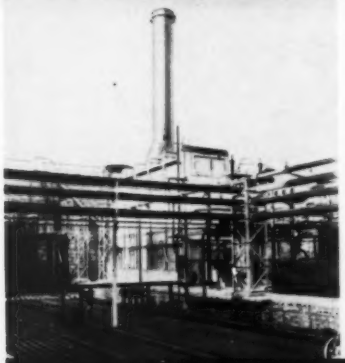
The evidence on earnings in the years 1938-1949, the most prosperous period in the history of the United States, disproves the common misconception that the oil business is extremely profitable. During this time earnings on net worth averaged about 11 per cent for large corporations in the oil industry compared with 12 per cent and 13.6 per cent for comparable corporations in manufacturing and trade, respectively, as shown by the annual studies of corporate net income by the National City Bank of New York (See Page 49). Only in the exceptional year of 1948 was the rate of earnings for oil corporations slightly higher than for the manufacturing and trade groups. A sharp decline in oil earnings followed immediately in 1949, reducing the average return again to a level less than that in manufacturing and trade. Another study of financial results for thirty large oil companies by the Chase National Bank shows average earnings on invested capital of less than 10 per cent for the period 1938-1949, a rate slightly lower than for the group of corporations included in the National City Bank reports.

The inadequacy of traditional accounting methods in relation to petroleum production creates an erroneous impression as to income tax payments by oil companies compared with other businesses. These methods result in overstating the real income properly subject to income taxes for two reasons. In the first place, they do not take into account that much of the reported income from production results from the sale of a capital asset (oil) and is different from ordinary income. The return of the capital value of oil in the ground, measured by percentage depletion, merely gives the producer a chance to maintain his real assets constant by replacing the oil produced. In the second place, the income shown in oil company financial reports generally fails to deduct the regularly recurring intangible development costs which must be made merely to maintain productive capacity. The oil producing business, unlike manufacturing and trade, requires constant expenditures of money for exploration and drilling merely to stay even from one year to the next. Allowance for these facts, which are not properly recognized by traditional accounting methods, is provided for in income tax laws to place oil producers on a comparable footing with other investors. The rate of income tax payment on the reported income of oil producing companies necessarily must be less under these circumstances than for the ordinary business to result in equal treatment with respect to real current income.

Since 1918, the regulations applicable to the determination of income have granted the taxpayer the option to charge intangible development costs as an expense when incurred or to capitalize them for recovery over a period of time. The option to expense intangible development costs, rather than to capitalize and recover them as depreciation over a period of time, does not change the fact that the operator is allowed to deduct his expenditure only once. The standard industry practice of charging intangible development costs as an expense and depreciating investments in tangible equipment was generally applied and fully recognized by the Bureau of Internal Revenue and Congress at the time percentage depletion was adopted in 1926. These different provisions were allowed because, taken all together, they were recognized as proper and necessary to protect against taxation as income the capital expenditures made in development as well as the capital value created through discovery.

The answer to the false argument that depletion and the option to expense intangible development costs constitute a double deduction can be summarized by noting that these distinct provisions for two separate purposes are both necessary to provide fair tax treatment, and that Congress adopted percentage depletion and determined the proper rate with the full knowledge that intangible development costs were allowed separately as an expense and would not be covered by the depletion provision.





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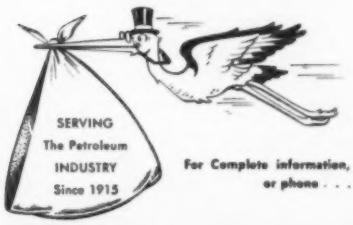

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Mason Heads McKee Personnel

The appointment of Walter C. Mason as director of personnel for Arthur G. McKee & Co. has been announced by H. E. Widdell, president. Mr. Mason will be in charge of all personnel and employee relations. He comes to McKee from the E. F. Hauserman Co., where he also served as the personnel director.

In addition to being an experienced personnel administrator Mr. Mason has lectured at a number of universities and colleges on personnel and industrial relations subjects. He is currently serving his second term as national president of The American Society for Personnel Administration and is an active member of a number of local and national technical associations.

Boyd Joins Born Engineering

L. A. Boyd has been appointed chief engineer for the Born Engineering Co., Tulsa, according to Dr. Sidney Born, president. Mr. Boyd, formerly chief engineer of the Texas Natural Gasoline Corp., and a member of the Oklahoma and National Society of Professional Engineers, comes to Born with an extensive background in processing, research, design and development.

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After college, he served in the U. S. Army and in 1917 worked as chemist for the Transcontinental Oil Co. His experience includes such various capacities as plant chemist, superintendent, district and general superintendent for Signal Oil and Gas Co., Los Angeles, and Gas and Oil Products, Calgary, Alberta. He was for the past eight years, chief engineer for Warren Petroleum Corp., in Tulsa, before joining the Born Company early this year.

Mr. Boyd is known in the industry as instrumental in the development of gas stripping of natural gasoline plants and also was one of the pioneers in the use of extensive air cooling in natural gasoline plants.

New Oil Recovery Process

A new development which has had some guarded publicity lately is the Orco process proposed by Oil Recovery Corp. which employs carbonated water in flooding. An experimental field installation has been operating in western New York for the past 18 months but another six months or so probably will elapse before results are published.

The Orco process was developed by James W. Martin, a consulting engineer who has specialized in carbon dioxide chemistry for the past 25 years. He formerly was with du Pont and the old Dry Ice Corp. of America. He states that he had added an efficient, cheap adjuvant to carbonated water to give results which were not attained in earlier CO_2 experiments. Corrosion is reported to be not serious. Costs are lowered by recovering and recycling part of the CO_2. Sands are not repressured but it is not indicated whether preferential wetting is employed. Only announcement is that "carbonated water modifies the condition of many oil sands so that oil is more readily recoverable than by present water flood procedures."

In its present application on properties of the Bradley Producing Corp., Wellsville, N. Y., the process may be considered a tertiary rather than a secondary recovery method since the lease was flooded out and the wells ready to be pulled when the experiment started. Core analyses showed oil content ranging up to 30 percent, however, in the wells which were ready for abandonment. Since no nearby, cheap supply of CO_2 is available at Wellsville the material is brought in as dry ice to minimize shipping costs. Secrecy attending the project has given rise to a good deal of comment in the industry. The Bradley five-spot wells are as "tight" as many a wildcat.

A producing company in the Mid-Continent is to begin a field test shortly. A large number of cores from that area have been tested by the Earlougher laboratories at Tulsa and have indicated that residual oil after application of the Orco process can be reduced to 7 to 10 percent of pore volume. Paul D. Torrey, Houston, has acted as a special consultant. One part of the research work has been in the direction of applying the process to primary as well as secondary recovery.

Financing of the development work has been by a group of men associated with New York investment houses. Directors of Oil Recovery Corp. are Francis Kernan of White, Weld & Co.; B. C. Schmidt and J. K. Schemmer of J. H. Whitney & Co.; Henry Sears and Charles E. Saltzman of Henry Sears & Co.; William Zeckendorf of Webb & Knapp, Inc.; and James A. Bentley, management consultant. Offices of the corporation are at 405 Lexington Ave., New York.

Gillespie Resigns CIMA Post

Captain Bart Gillespie, general manager of Mexican operations for the Mexican-American Independent Co. (Cima) has resigned his position to devote his time to other interests. He will be succeeded by George Calleya, an oil man of broad experience in the United States and foreign fields.

Curtis B. Smith

Curtis B. Smith, for 35 years an advertising executive with Socony-Vacuum Oil Co., Inc., died January 18 at New London, New Hampshire after an illness of six months. He was 63 years old.

Some Requirements for Future Progress in Geophysical Prospecting

(Continued from page 51)

Corporation had observed other empirical results from which the same inference could be drawn. If these conclusions were correct, a bed mapped by the seismograph below a sand bar would show up as illustrated by the dashed line on Reflecting Horizon No. 2 in Figure 2. A time interval cross section between Reflecting Horizons No. 1 and No. 2 should show a pronounced thickening at the bar position as illustrated in Figure 3.

Experimental lines across the known parts of the field substantiated the above conclusions and commercial work followed which accurately predicted the extended position of the bar. The technique is being further developed and the company is of the opinion that it offers a distinct contribution to exploratory seismology.

This illustration is given to show that an intimate knowledge of both geology and seismology was necessary in this instance for the development of a successful technique. Most of the items of knowledge necessary for the formulation of the basic theory for mapping sand lenses were known to someone but they had to be assembled in one mind before they could form a prospecting tool. Other successful solutions to difficult problems of geophysics will be evolved when the present knowledge of both the geological and geophysical professions is fully combined.

E. A. Eckhardt, Gulf Research and Development Company, in his paper "Geophysical Activity in 1949"** shows comparative statistics of geophysical activity and discovery rate of petroleum reserves. In 1937 between three and four billion barrels of oil were added to the nation's reserves. The discovery rate dropped to less than two billion barrels in 1943 but climbed gradually to a peak of nearly four billion barrels again in 1948. The ups and downs in the "added reserves" statistics are preceded by similar ups and downs in the "seismic activity" curve. However, twice as many seismic crews were in operation in 1948 as in 1937 although approximately the same amount of reserves were added in these two peak years. The conclusion that must be drawn from these statistics is that a barrel of oil was at least twice as hard to find in 1948 as in 1937. This geometrical increase in exploratory effort with respect to volume of reserves added will probably continue. However, if enlightened management will provide the necessary brain-power hours, and if the geologists and geophysicists will consolidate their present knowledge, there exists the possibility that the trend can be arrested or even reversed.

** Geophysics, July 1950.

Medical Research Enlarged

Standard Oil Development Co. is undertaking medical research at its Linden, N. J., laboratories under the direction of Dr. Robert E. Eckart. Sections will be devoted to industrial hygiene, toxicology and clinical research. The research division formerly was incorporated in the Standard Oil Co. (N.J.) medical department.

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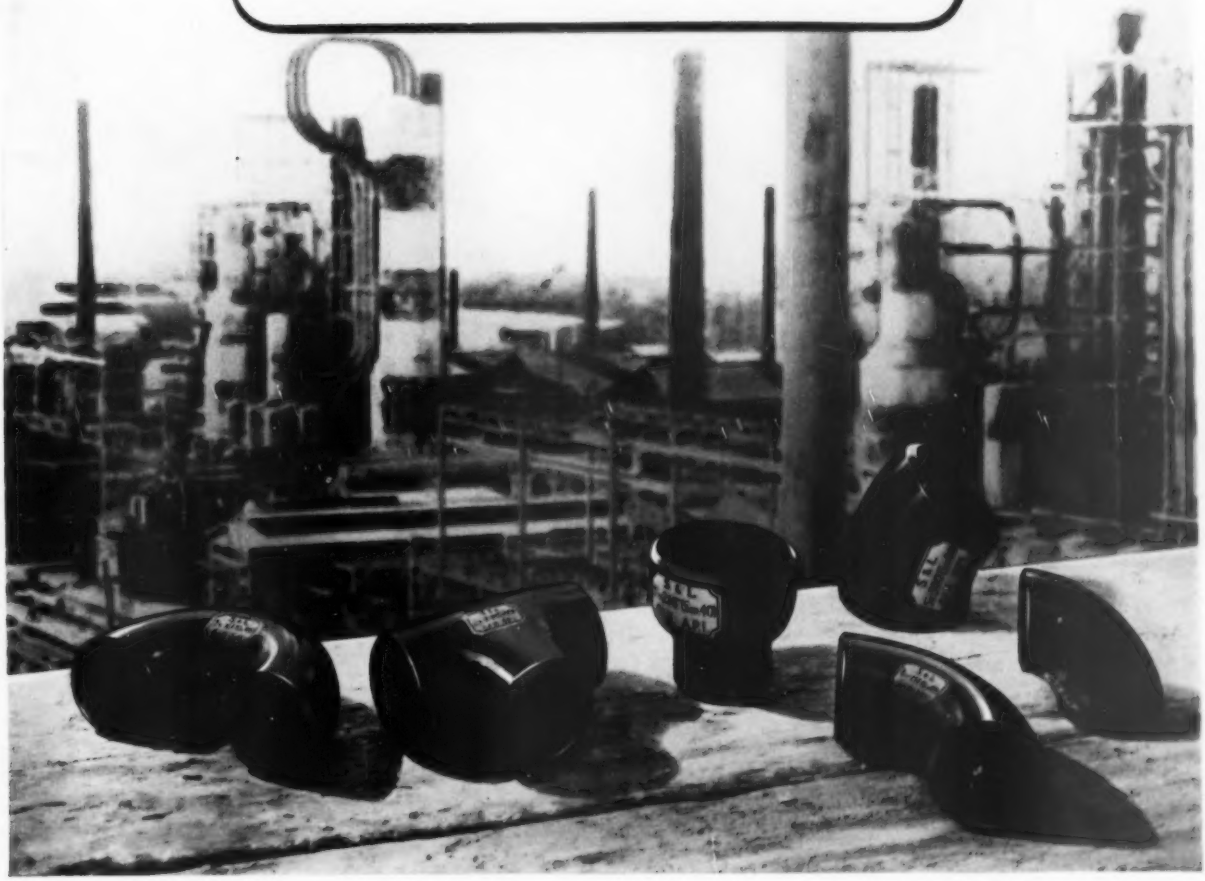

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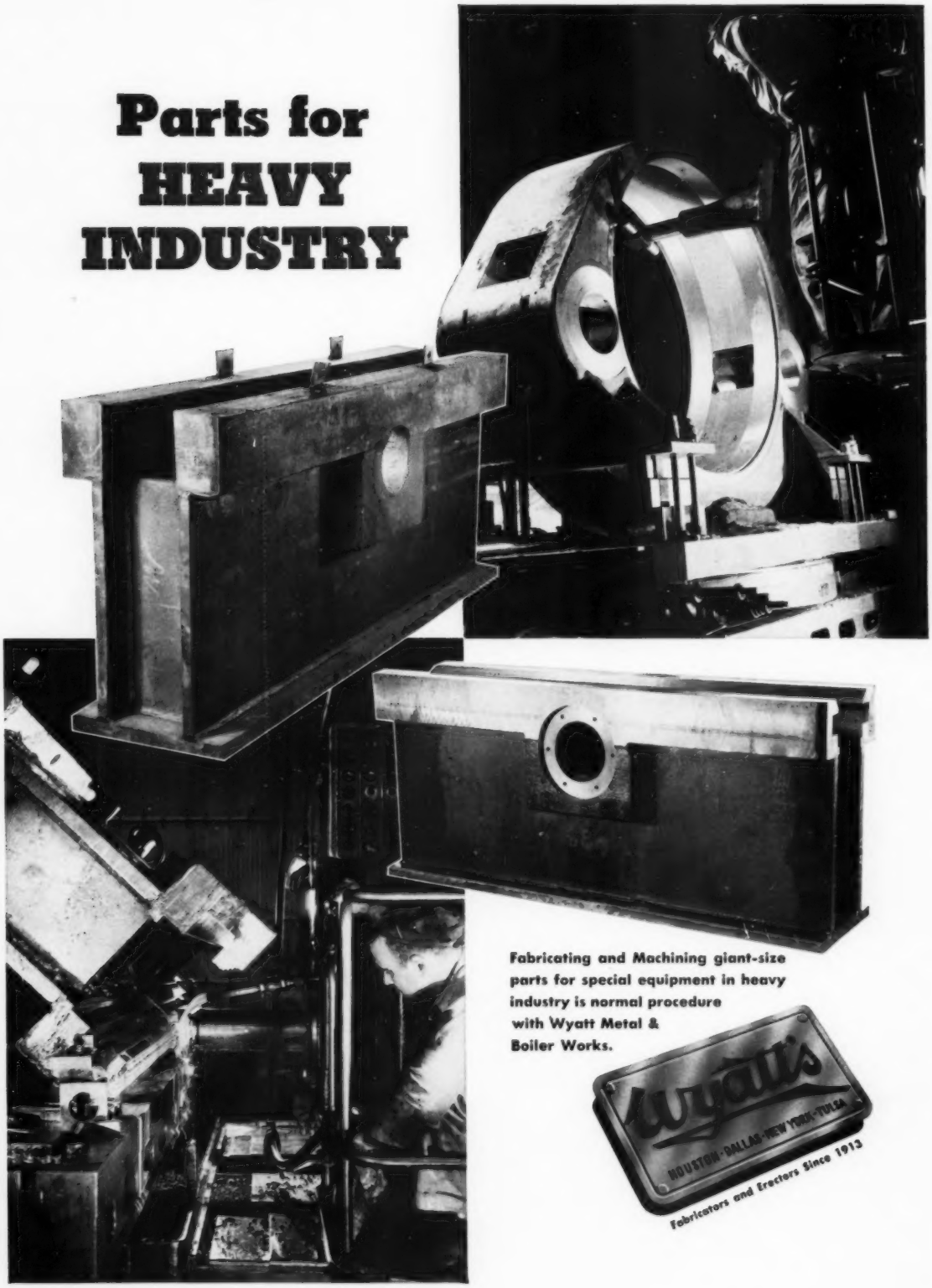

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